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Science and technology for basic needs: a bridge

Report of the Panel

Pursuant to Economic and Social Council resolution 1993/74, the Panel on Technology for Small-scale Economic Activities to Address the Basic Needs of Low-income Populations has completed its work. The report of the Panel is submitted to the Commission for its consideration.

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EXECUTIVE SUMMARY

1. Technological progress has been responsible for vast improvements in the physical conditions and living standards of the majority of the world's population. While, technologically, the world has never been in a better position to improve the conditions of the very poor, roughly 20 per cent of the world's population has not benefited materially from advances in technology. Their basic needs remain a most critical problem. The Panel on Technology for Basic Needs is seeking to refocus the world's attention on this grave question. It has defined basic needs as those minimal requirements needed for sustaining life of all the people, and encompassing adequate nutrition, health care, water and sanitary facilities, and implying access to education and information enabling individuals and communities to participate in productive activities and rationally use the basic goods and services available. The Panel agreed that priority should be given to technology strategies, approaches and policies, rather than specific technologies, and a pragmatic and pluralistic approach investigating the potential of diverse types of technologies. In reviewing experience with basic needs programmes, as well as relevant work on technology and basic needs carried out within the United Nations system, it was found that scant attention had been given to the role of technology in alleviating poverty. One problem was a failure to replicate successful cases sufficiently, and instigate a systematic effort geared to the application of technology to basic needs. Nevertheless, it was found that those nations which had launched determined and protracted campaigns to provide basic needs were, in a number of cases, able to demonstrate progress.

2. The fundamental objective of the technological facet of meeting basic needs was defined as follows: creating participatory conditions that increase the ability of the poor to generate, access, comprehend and creatively use technologies in order to satisfy their basic needs. The Panel emphasized the importance of six bridging elements or "pillars" linking technology to basic needs satisfaction and elaborated specific recommendations. The six complementary bridging elements are: (a) education; (b) access to information; (c) participation; (d) health; (e) basic infrastructure; and (f) small-scale economic activities. Special recommendations for action were formulated for science and technology policy for basic needs.

3. Among the recommendations are: the promotion of a conference to sensitize the scientific and technological community and policy- and decision-makers to the issue of science and technology for basic needs; periodic reviews of basic needs programmes by decision- makers; the monitoring of basic needs indicators and the implementation of a mechanism for evaluating country science and technology policies in terms of how adequately basic needs satisfaction is being addressed; a "one stop" referral service to information networks and the strengthening of networking of science and technology institutions and enterprises of both private and public sectors, at national and international levels; the promotion of programmes for financial delivery to micro/small and medium-sized enterprises; the launching of a pilot programme involving different countries from different regions, to report to the Commission. Finally, it is recommended that technology for basic needs be addressed in a series of sessions involving the Commission, as well as in a joint session of the Commission with the Commission on Human Rights.

INTRODUCTION

4. The concern with technology for basic needs is motivated by the grave and widening fissure between the very poor, representing approximately 20 per cent of the world's population, and the remaining majority. Closely associated with this growing gulf is the serious discontinuity—and one that is also becoming more severe—between the day-to-day existence of those living with basic needs deficiencies and the corpus of scientific and technological knowledge as well as the concerned global scientific and technological community. The perception of a chasm, fracture or rupture was the primary inspiration for the "bridge" metaphor in the title of the report. The predominant theme throughout is the

devising of bridging mechanisms between the very poor and the technology access that is enjoyed by the majority of the planet's population not plagued with basic needs deprivation. The bridge, as elaborated below, is comprised of six complementary elements: education, access to information, participation, health, basic infrastructure, and small-scale economic activities. These bridging elements, or pillars, are founded on science and technology (S&T) policy for basic needs satisfaction.

5. The problem of unmet basic needs is intimately connected with other worrisome facets of the human condition. One pertains to the fact that the majority of the world's very poor are either women, or children and the elderly who are ordinarily dependent on the care of women. This is a telling symptom of fissures along gender lines. Similarly, there is a disarticulation between humanity and nature that is leading to mounting ecological and environmental problems, some of which affect regions far beyond the countries where the problems originate. Once again, the question of basic needs is relevant since some of the most egregious ecological degradation is associated with regions characterized by extreme poverty. Patently, sustainable human development is not compatible with these widening gulfs; fashioning, maintaining and improving adequate bridges is a prerequisite to long-run improvement of the human condition. The bridge emphasized in this report, namely between science and technology and basic needs, is closely associated with, and complementary to, measures designed to resolve gender and environment-related difficulties.

I. BACKGROUND

A. Origin of the Panel

6. The Commission on Science and Technology for Development, at its first session in April 1993, identified, as one of the themes for its inter-sessional work, the issue of technology for small-scale economic activities, to address the basic needs of low-income populations. In pursuance of Economic and Social Council decision 1993/320, the Commission established a panel of its own members to be responsible for preparing a draft report on this issue for consideration by the Commission as a whole, at its next session. Additionally, resolution 1993/74 of the Council on the future work plan of the Commission indicated that, when examining the above theme, the Panel should build upon relevant studies from inside and outside the United Nations system, including the regional commissions, the United Nations Conference on Trade and Development (UNCTAD), the United Nations Industrial Development Organization (UNIDO), the International Labour Organisation (ILO), the Food and Agriculture Organization of the United Nations (FAO), the World Bank and the regional development banks.

B. Focus of the Panel's work

7. At its first meeting, the Panel defined its task as a review of technology in relation to basic needs, and discussed how fresh approaches to science and technology could ensure that the basic needs of low-income populations were met. Following the suggestions made by the Bureau of the Commission, the Panel decided that its work would focus on food production and processing, education—especially technical and vocational training—and health care. The Panel agreed that technology strategies, approaches and policies, rather than specific technologies, should be given priority in the course of its work programme and that, in accordance with Economic and Social Council resolution 1993/74, emphasis should be given to dissemination mechanisms, including training, regional and international cooperation as well as capacity-building and research and development activities.

C. Method of work

8. The Panel on Technology for Small-scale Economic Activities to Address the Basic Needs of Low-income Populations held a total of three sessions: from 2 to 3 June and 17 to 18 October 1994 and 18 to 20 January 1995. The Panel is comprised of representatives from countries members of the Commission on Science

and Technology for Development and who had indicated an interest. Mr. Arnoldo Ventura, a member of the Commission, Special Adviser to the Prime Minister on Science and Technology, Jamaica, was elected Chairman of the Panel. Representatives of a number of international organizations also participated in the deliberations of the Panel (see annex I). The Panel's work has been based on inputs from its members, international organizations, and issue papers prepared by international consultants. At the request of the Panel, the UNCTAD secretariat undertook a review of the work of the United Nations system and selected organizations dealing with technologies for basic needs.[1] This material, together with the exchange of views and deliberations at meetings of the Panel, has served as the basis for the present report. The Panel wished to record its gratitude for the generous contribution of the Government of the Netherlands to its work. It also recognized the valuable support of the experts who acted as "Friends of the Chairman" (see annex II).

II. BASIC NEEDS IN A CHANGING LANDSCAPE

A. Concept

9. Basic needs have been defined in different ways, but a representative perception of the concept is that of Frances Stewart who sees the approach as "one which gives priority to meeting the basic needs of all of the people. The actual content of basic needs have been variously defined: they always include the fulfilment of certain standards of nutrition (food and water), and the universal provision of health and education services. They sometimes also cover other material needs, such as shelter and clothing, and non-material needs such as employment, participation and political liberty."[2] A review of literature and case studies has divulged that a considerable amount of work has been devoted to the basic needs issue, but the dominant themes concerned attempts to identify and quantify features of basic needs and evaluate programmes designed to meet them. The studies concentrated on methodological and statistical aspects of basic needs, such as elaborating on specific country, regional or sectoral data; identifying population segments lacking goods and services; outlining the characteristics of basic needs, searching for indicators to measure the extent of those needs, and attempting to define common grounds and understanding which could help in formulating targeted policies; evaluating countries' performance in meeting basic needs. The role of technology, its application and diffusion, and its policy-related aspects with respect to basic needs was scarcely reflected in this material.

B. Current developments

10. We live on a planet that has experienced sweeping technological, economic, political and social change, over the past two decades. This has affected the fundamental nature of the problem of poverty and, to a great extent, impinges on the possibility of realizing sustainable human development. Politically, there are shifts in the distribution of power both within and among nations. Countries in transition to a market economy are seeking to redirect the emphasis of resources for science and technology.[3] Although there are potent interactions and feedback mechanisms operating among these facets in the new landscape, technological change is the primary driving force. Economically, it is changing the structure of production all over the world and, in consequence, affecting comparative advantages, international division of labour, income levels, productivity, employment, skill profiles and patterns of international commerce, among other economic variables. With microelectronic innovations in the vanguard, and modern biotechnology and new materials science rapidly coming on stream, new emerging technologies are affecting the human condition and prospects profoundly. These emerging technologies are more mobile, flexible and knowledge-intensive than ever-before, but at the same time less energy- and resource-intensive. Also, while technology transfer remains important, it is now subordinated to the desire to accumulate more domestic technological capabilities, an aspect which did not carry quite the same weight in earlier basic-needs related programmes.

11. In the new global economic panorama, a transfiguration has led virtually every country to make some move towards deregulating its domestic economy and liberalizing its trade regime; many nations have accomplished drastic shifts towards more market-oriented, outward-looking economic systems; the ability to become competitive domestically and internationally is all-compelling. On the world political scene, there has been a significant movement in the direction of democratization and assertion of human rights which present new avenues and opportunities for formulating policies directed at basic needs satisfaction. Along with a tendency to decentralize political control, democracy signals a more propitious atmosphere for widening and deepening participatory behaviour which embraces poor populations. Moreover it has created a more favourable climate for linking basic needs satisfaction to human rights. Taken together, economic liberalization and political democratization point to reduced reliance on paternalistic, top-down approaches in favour of policies encouraging broader participation by key actors, including the poor. Closely related to this are the current political contours which encourage decentralized decisions and problem solving, a trend laden with both challenges and opportunities for effectively broaching the subject of deficiencies in basic needs satisfaction.

C. Poverty, income polarization and technological progress

12. Over the past several decades, technological progress, supported by the new economic and political arrangements, has been responsible for vast improvements in the physical conditions and living standards of the majority of the world's population. This trend can be substantiated by examining indicators such as rising per capita income, life expectancy and infant mortality. For millions, technological progress has satisfactorily resolved the basic needs problem. While technologically the world has never been in a better position to improve the conditions of very poor populations, roughly 20 per cent of the world's population has not benefited materially from advances in technology.

13. In many parts of the world the poor, especially poor women, are losing ground in terms of income and amenities relative to the remainder of the population. During the period 1980 to 1991, the least developed countries experienced a rate of growth in per capita income of 0.7 per cent in contrast to a rate of 2.1 per cent by developed market economies. Meanwhile, their per capita food production actually declined between 1980 and 1992, at an annual rate of 1.2 per cent.[4] The World Food Council estimated that in 1992 there were 550 million hungry people in the world, a number which jumps to around one billion when those vulnerable to periods of hunger each year are included.[5] In 1981 average per capita output in developed countries was about 20 times greater than in developing countries; by 1991, the ratio had expanded to 22 to 1.[6] Looking at the polarization problem somewhat differently, ECLAC estimated that in 1960 the world's highest income quintile received average incomes 30 times higher than the population in the lowest quintile; in 1990 the disparity had grown to 60 times greater. The same organization estimates that 45.9 per cent of Latin America's population is below the poverty line, an increase of 2.5 per cent since 1986; 22 per cent are in extreme poverty.[7] The World Bank estimates that the number of people living on less than one United States dollar per day (1985 prices) rose from 1.051 million in 1985 to 1.133 million in 1990.[8] In a news release following the recent IMF-World Bank Summit in Madrid, the World Bank's President, Lewis Preston, pointed out that in the next generation there will be 3 billion more people with desperate needs for clean water, sanitation, electricity and other basic needs. By no means is income polarization confined to the South. The United States Congressional Budget Office reported that between 1949 and 1989, the lowest quintile saw a decrease of 10 per cent in real income whereas the highest 1 per cent increased their income by 105 per cent.[9]

14. These conditions have contributed to a greater marginalization of poor populations and a feeling of alienation and hopelessness. The term "marginalization" is intended to convey that the poor are excluded and have no route through which they can influence the distribution of power or resources in ways that might be beneficial to them. It does not imply that they have no visibility or influence on the lives of the non-poor. The basic needs problem

means that, directly or indirectly, populations that are not impoverished are subjected to a variety of detrimental impacts. They suffer a heightened sense of insecurity, run higher health risks, incur increasing expenses for personal protection and are subjected to relatively higher tax levels. In many of the world's nations, partly owing to technological advances coupled with a greater emphasis on competitiveness, the middle class and elites already suffer from less job security amid growing anxieties, augmented in view of the increasing violence and criminality of those with basic needs deficiency.

15. In the experiences of three least developed countries[10]—Ethiopia, Togo and Uganda—the problem of extreme poverty appears as the most dramatic feature. In Ethiopia, for example, almost 51 per cent of the population lives below the absolute poverty line. Other salient aspects found in these countries were the predominantly rural population and the extremely high proportion of youth under 15 years of age, resulting in a high level of dependency in the total population. The overwhelming majority of the economically active population in the rural areas and a great portion in the urban sector is made up of self-employed workers. Health coverage, sanitary conditions and, accordingly, life expectancy, are low, as are education facilities. Consideration of these aspects is fundamental to formulating a strategy for technology aimed at the satisfaction of basic needs, which is seen as almost synonymous with formulating national economic development objectives in general.

16. Previous models for attacking the basic needs situation have become inadequate; there has been a "sea change" in important facets of the human condition that renders earlier models at least partially obsolete. Those denied the possibility of meeting their basic needs are fiercely expressing their social discontent. Increasingly, their situation presents the greatest challenge for socioeconomic development, and has acquired environmental and national security dimensions. The Jamaican case[11] demonstrated clearly that "an assertive attack on the basic needs problem goes far beyond the traditional poverty alleviation strategies tried unsuccessfully in the past. A local basic needs approach calls for a greater emphasis on domestic technological competence and management, a greater absorptive capacity of the benefits of S&T among those most in need, and a wider spread of the fruits of growth through decentralized production and consumption..., as well as popular participation...."

17. Deleterious poverty-related effects are no longer compartmentalized within poor countries and, putting it bluntly, the extreme poverty is adversely affecting the quality of life of all the world's population. The spirals of less security and more expenses; of cultural, ethnic, religious and social fractures; and of North to South interventions, are not sustainable. This is the primary reason why a fresh strategy is being sought for solving basic needs deficiencies, consonant with the new technological, economic, political and social realities. Several other factors of paramount importance also figure in this context: first, and absolutely central to the discussion, market forces can be and should be constructively and imaginatively employed in ameliorating abject poverty; however, for improving the conditions of the very poorest segments of society, extra-market interventions are a prerequisite. In achieving the goal stated above (in paragraph 2), a fundamental condition is the fashioning of avenues, bridges or linkages through which the poor can breach the expanding knowledge and technology gap that perpetuates their economic, political and socio-cultural marginalization; secondly, the focus must be aimed at and maintained squarely on human beings — "things" such as technology and knowledge are important, but only as they relate to human beings and how they are deployed and manipulated for the betterment of the human condition and further sustainable human development; thirdly, the process of combating basic needs deficits is value-laden: ethical and attitudinal considerations influence the chances for, and the extent of, succeeding. A primary ethical element is the challenge to the global science and technology community to recognize that, by having the capacity to make significant contributions to resolving basic needs problems, with this capacity comes an associated responsibility and moral obligation. As regards attitudes, the battle will entail moving from passivity, a sense of inferiority and a feeling of helplessness to active participation, with confidence based on

collective and individual achievements and justifiable hope. These and perhaps other matters of value will interact powerfully with access to and deployment and use of science and technology for poverty alleviation.[12]

III. TECHNOLOGY-RELATED APPROACHES FOR SATISFYING BASIC NEEDS

18. There follows a brief examination of three technology-related approaches to solving basic needs' shortfalls. First, a review of experience in the informal sector indicates that a substantial number of micro-scale and small enterprises are capable of undertaking technical innovations. Secondly, two alternative levels, appropriate technology and technology blends, are singled out for review since both are explicitly dedicated to raising the living conditions of the poor. Thirdly, there is an appeal for the employment of "technological pragmatism", an approach that does not automatically exclude any level of technological sophistication that might contribute to the cause of diminishing basic needs' deficiencies. Finally, in view of the discussion, case studies are presented that illustrate a variety of experiences regarding the application of technology for basic needs.

A. The informal sector

19. Traditionally, the informal sector has been associated with strategies for meeting basic needs because of three important factors: (a) its role as producer and supplier of basic goods and services at prices which could be afforded by the poorer section of the population; (b) its capacity to absorb the rapidly growing urban labour force and generate income that enables the urban poor to satisfy its basic needs; and (c) its application of technologies appropriate to local factor endowment. These characteristics, coupled with easy entry into the sector, its size, structure and capability to adapt to changes, render the informal sector one of the most important components of any basic needs' strategy. The informal sector, particularly in urban areas, has recently been expanding and proliferating. In some cases, especially where major trade and industrial policy reforms have resulted in the contraction of the formal sector, they are providing the majority of urban jobs and supplying goods and services essential to the poor. In African countries in particular, informal sector activities now employ more people than the formal sector and provide higher incomes than do rural sector activities.

20. Concerning technologies for basic needs, the key question is whether the technologies used in the informal sector are conducive to basic needs' satisfaction and, more importantly, whether the sector has the potential to undertake technological upgrading.[13] A collection of studies on the technological capabilities of Third World informal sector enterprises in metal-engineering activities reveals that some firms are capable of accumulation of capital, upgrading of equipment to successively more sophisticated levels, self-construction of hand-operated equipment or tools, development of new product designs, improvement of product quality, inputs of new materials, investments in human capital, and, in some cases, production of capital goods required by other informal sector enterprises.[14] A review of the literature has uncovered considerable corroborative evidence of the innovative abilities of micro and small enterprises, many of which are in the formal sector.[15] Despite some major handicaps, the informal sector also is able to exhibit innovative behaviour, which implies that, under more favourable conditions, technological progress in the sector could be more robust and the rate of "graduation" to the formal sector, a rate now quite low, could be accelerated.

B. Alternative technologies

21. Although they cannot be defined in water-tight compartments, several levels of technological sophistication can be distinguished. Traditional technologies are those employed over an extensive period of time and which tend to be well-adapted to local culture and habits. Conventional technologies are those which have proved to be commercially viable with progress resting mainly on engineering

innovations and scaling up for larger markets. Emerging technologies are relatively new and primarily science-driven. In addition to these levels of technological sophistication, there are two other technological "alternatives", namely (a) intermediate or appropriate technology and (b) technology blends.

22. Intermediate technology, later designated appropriate technology, was popularized in the early 1970s as being a technological level somewhere between traditional and modern (conventional and emerging) technologies.[16] There is no universally accepted definition of appropriate technology, but usually, compared to modern technologies, it is characterized by all or most of the following attributes: it is labour-intensive; its productivity is on smaller scales; it is ecologically "friendly"; it requires less demanding worker and managerial skills; it utilizes more local inputs; it requires a lower investment per job created. Appropriate technology has been criticized for not accomplishing enough to benefit the poor. Its application had a checkered record in the early days and, all too often, successes were very geographically circumscribed or confined to a single application; any spread to alternative uses and the development of complementary innovations was not always in evidence. Yet, appropriate technology might well be a valuable tool for combating extreme poverty; high-impact appropriate technologies include: systems for delivering micro-loans like those inspired by Bangladesh's Grameen Bank; bamboo tube wells in southern Asia; improved cookstoves in China. Furthermore, appropriate technology had been hampered by a disinclination to commercialize the venture and a tendency to connect such technology with a subjective vision of a proper life-style rather than to the effectiveness of technology. For organizations promoting technological development in developing countries, such as the Intermediate Technology Development Group, Volunteers for International Technical Assistance, and scores of other agencies, these shortcomings appear to have been largely overcome. It is suggested that the sizeable and growing arsenal of appropriate technologies should be taken seriously in any process of screening and selecting technologies for poverty-related projects.

23. Another technology-related approach, technology blends, began to be investigated about a decade later. Technology blending, as it is now customarily known, entails the constructive integration of emerging technology into low-income, small-scale economic activities in developing countries, with the important proviso that, as the word "blending" implies, the introduction of the emerging technology should blend with and preserve at least some of the prevailing traditional production techniques.[17] The original impetus for investigating technology blending came from the former United Nations Advisory Committee on Science and Technology and a small but growing literature has resulted.[18] The literature includes cases in which modern biotechnology, laser technology, new materials sciences, microelectronics innovations, satellite communications and photovoltaic power have been blended with such traditional economic activities as small-holder agriculture, agribusiness, service delivery systems for the poor, informal urban enterprises, and small- and medium-sized manufacturing.[19] As expected, some technology blending efforts have run into difficulties and some involve trade-offs between gains and losses in meeting various goals; however, the incidence of clear-cut successes would appear to warrant more vigorous experimentation and increased efforts to alert the scientific and technological community to them, as well as calling the attention of developing country decision-makers to the potential benefits flowing from a marriage of indigenous and high technology.

C. Technology pragmatism

24. While appropriate technology and technology blending were singled out for discussions, as these levels of technologies are expressly geared toward bettering the lot of the poor, it should be stressed that the application of conventional and emerging technologies can, under the proper conditions, yield gains in providing goods and services for satisfying basic needs. Very high technologies were involved in developing oral rehydration salts; sophisticated computer techniques were employed to develop wind-powered electricity generation for developing countries and likewise to get the correct degree of porosity for

small dams in India; and frontier technology was applied to developing an environmentally friendly brick-firing kiln for small brick producers in Mexico. Whether these and similar technological advances constitute examples of appropriate technology, technology blends or emerging technology is considerably less important than the fact that they work effectively. What seems called for is a multi-layered technological approach, that is, "technological pluralism". This rests on the more fundamental principle of "technology pragmatism"—an eclectic search for the best technological means to satisfy basic needs, given the prevailing set of constraints and opportunities inherent in each situation.

D. Recent experiences

25. A few selected cases are summarized below. They illustrate some of the efforts undertaken by developing countries to tackle basic needs satisfaction, dwelling in particular on technology dissemination and commercialization, on the correlation between education and nutrition, and between human resource development and technology adaptation, innovation and R&D.

26. In connection with the advent of the "green revolution" during the 1960s and 1970s, an interesting case is that of the Punjab, an Indian agrarian state. The "green revolution" increased yields and brought overall prosperity to rural workers.[20] Despite their limited land base, marginal and small farmers of the Punjab were able to record almost as much total crop output and farm business income per acre as their larger counterparts, primarily because of a much higher cropping intensity through a rational year-round use of their family labour, implying a highly skilled use of techniques and resources. The Punjab case shows that agricultural and industrial development and the application of technology are best viewed as interlinked and supportive: the growth of agricultural productivity was based on the application of science and the introduction of modern industrial inputs, for example, fertilizers and capital goods, and irrigation facilities. In this case, the Government of India played a major role in organizing the provision of necessary agricultural inputs to the individual farmers through credit facilities made available by state-supported cooperative societies, as well as the necessary infrastructural framework— roads, markets, the agricultural university and agricultural extension services.

27. Technology commercialization and diffusion are taken up in detail in a recent volume which concentrates on how to transform the Indian rural economy.[21] An overview of the various cases presented reveals that in developing countries the large percentage of the population living below the poverty line does not have the purchasing power to articulate its demands through the market; neither can the market alone channel goods and services to a population basically engaged in subsistence production.[22] The study stresses the magnitude of the technology gap between rural and non-rural sectors and the low agricultural productivity levels which reflect low technological levels. Technological diffusion in the Indian rural sector has also been hindered by lack of qualified skills, largely owing to the so-called "rural skill drain". Another factor is the lack of adequate research and development projects designed to improve rural technology. However, some of the limitations suffered by the small-scale producer in the rural sector - such as limited access to credit, information, services and infrastructure - have been overcome by combining traditional and modern elements of technology, through the so-called technology blending process, including initiatives at down-scaling of modern technology to suit different levels of scale, energy and modes of production.[23] Finally, the importance of a suitable macroeconomic policy environment is stressed. Such policy is essential in order to generate demands for improved technologies that respond to rural sector requirements.

28. Other experiences have been reflected, for example, in case-studies on Mexico[24] and on Ecuador.[25] The case of Mexico points to the strong correlation between educational levels and under-nourishment, and to the differences between urban and rural sectors. For example, 41 per cent of the heads of households in the malnourished groups had no formal education at all, and around half of them were economically active in agricultural tasks. The case-study of Ecuador

provides elements for analysing the performance in meeting basic needs during the 1970s and up to 1982; it includes recommendations for improving backward and forward linkages between agriculture and industry, and for specialized industrial development to provide fertilizers and appropriate machinery to foster agricultural development. Such development is critical for overcoming the input supply bottlenecks of agro-industries and of food-processing industries, which also suffer from a general lack of inter-industry integration. Rural industry is a recognized important employment generator, but lacks major technological development and faces infrastructural and marketing problems. This case-study also points out that, in many consumer industries, linking up with various technological levels will be necessary if the objectives of employment-creation, income-generation and reduction of overall production deficits are to be satisfied simultaneously; too much emphasis on small-scale labour-intensive industry may imply the sacrifice of growth objectives.[26] The study proposes a selective type of import-substitution policy based on a criterion of meeting basic needs; such selective policy must not discriminate against potential export industries. Finally, the role of income redistribution policy in respect of low-income groups is stressed, and particularly its importance in expanding the domestic market.

29. An analysis of the educational characteristics of technology innovators in the small metalworks industry in Peru shows the importance of training for technology adaptation and innovation.[27] Of a group of 13 successful entrepreneurs engaged in activities connected with adaptation and innovation, nearly two-thirds (61 per cent) had followed university studies for an average of about five years. Seven of them had followed courses or technical careers for an average of two years. Only one of the entrepreneurs had not benefited from university or higher level technical studies although he had attended a particular secondary school which had offered technical components in its curricula. The study also showed that the majority of these entrepreneurs had previous working experience in the same field; the author considers that such working experience also constitutes a form of training. In the area of research and development and in technological dissemination, an important experience is reflected in the case of the transfer and adaptation of a technology for milk substitution in the Andean Group.[28] On the basis of multidisciplinary and multinational team work, several technological alternatives could be developed to solve critical nutritional problems of developing regions. The experience proved that research and development of new, low-cost products for meeting the pressing needs of the majority of the population should be directed towards solving clearly identified problems, include studies of the characteristics of the economic sector and the consumers to be served, and be supplemented by activities aimed at promoting the market for the resulting products.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions and recommendations for the six "pillars"

30. The experiences reviewed showed diversity in technology choice, economic policy orientation and the interaction among the main actors in the society. The experiences of "good performers" suggest that success in meeting basic needs is intrinsically related to, *inter alia*: significant investment in education and health; clear priorities including the targeting of the "right groups". In line with this, the promotion of technology generation, research and development (R&D) and the diffusion and wider application of R&D results, the development of infrastructure and support services, the development of adequate delivery systems, and a favourable macroeconomic environment, are all contributing factors.

31. The review of trends and experiences also indicated that, while the satisfaction of basic needs of the bulk of the population in the developing countries is far from being met, and indeed, in some cases, has deteriorated, this objective holds a key position in the development efforts of many countries. However, the role that technologies play in satisfying basic needs has so far

received only limited attention. In looking forward, therefore, it is vital that satisfaction of basic needs be examined together with the role of technologies in production and services, including the contribution that new technologies can make to upgrading production processes and the knowledge base of skills, all of which appear to favour pluralistic and pragmatic approaches to technology. From a policy point of view, diverse case-studies examined during preparation of this report not only call for the improvement of technology, its development and diffusion, but underline the need for "new institutional blends" that will promote basic needs satisfaction. These include diverse forms of partnerships among governmental, non-governmental and private sector entities, including the scientific/technological research *cum* teaching institutions. The importance is stressed of a suitable macroeconomic policy environment, embracing industrial and trade policies, investment approaches and price policies to ensure favourable terms of trade for rural sectors. In addition, the need for specific technology policies for improving the competitiveness of small enterprises, promoting technological improvements, upgrading the quality of products, and ensuring adequate quality control is also emphasized. In these efforts, human development programmes are considered crucial.

32. Six integrating themes were identified as a focus for grouping recommendations. These were considered as main "pillars" in the effort to tackle the question of basic needs fulfilment resting on a sound science and technology policy foundation. The pillars are: (a) education, (b) information, (c) participation, (d) health, (e) basic infrastructure, and (f) small-scale activities.

Education

33. Education is an area where economic gains from meeting basic needs are most distinct. Investment in primary education in developing countries has very high rates of return, both for society and for the individual.[29] These monetary returns do not take directly into account mutually reinforcing non-monetary returns especially pronounced with respect to the education of women, such as reduced child mortality, altered fertility patterns and better human development in general.[30] Differences in educational attainment are extremely important in explaining differences in income.[31] Donors and nations suffering serious basic needs deprivation could make the provision of quality education a cornerstone of their basic needs strategy.

34. The concept of "education" as used here has connotations that go beyond those traditionally ascribed to the term, that is, almost exclusively the process of formal education. Education for increasing the capacity of the poor to gain access to and understand technology must create the instruments that are indispensable for progress. To this end the following objectives are suggested: (a) education for increasing production and productivity of small-scale economic activities; (b) education enabling the poor to participate effectively and constructively in community life; (c) education enabling the poor to put into practice policies and programmes of preventive medicine, indispensable for improving the levels of health and nutrition; and (d) education for the poor that will give impetus to a process of sustainable development, that is, one that will preserve and protect the environment. Accordingly, education expenditures and curricula should be carefully reviewed and evaluated in terms of these objectives. Nations with significant shortfalls in meeting basic needs would benefit from undertaking a review of the composition of their education expenditures in terms of primary, secondary and higher education, and the geographic configuration of these expenditures. Thus they could determine whether the composition and pattern of investment in education is consonant with optimal social returns and basic needs objectives. In reviewing their school curricula, careful attention should be devoted to seeing that students are taught science in a manner that is meaningful and that they are exposed to techniques of production relevant to future income-generating activities. Countries should be cognizant of new effective technologies for assisting the process of education that involve computer networking and other micro-electronics-based tools for learning.

35. Technical assistance and extension services for micro and small enterprises (MSEs) can reach the poor through delivery systems that function well.[32] Careful comprehensive surveys could be made of existing programmes for supporting technical improvement of small enterprises and those that seem best suited to the circumstances adopted. International agencies can furnish the raw material, for example, through evaluative case-studies. Such surveys have been initiated by specialized United Nations agencies, for example the International Labour Organisation, in the case of a delivery system for Ghana. International financial institutions and non-governmental organizations can play an important role (c.f. biovillage experiments cited in footnote 32).

36. Clearly overall responsibility for providing education to the very poor rests with national Governments, although regional and local levels can make valuable contributions, not the least by making suitable adjustments for local circumstances. As to training, private and public sector partnerships may well be practicable also. Donors and education administrators should possibly give first priority to the teaching of teachers and the training of trainers rather than to the building of new schools. Decision-makers in countries with a deep low-income social strata and, in fact, the entire global scientific community must become more aware and more sensitive to the potential contributions which science and technology can make to improving the income, productivity and quality of life of the very poor. This is of the utmost importance. An effort needs to be launched and vested with sufficient international prestige and publicity to galvanize further actions aimed at rechannelling, to some extent, the direction of the world's scientific and technological undertakings.

Access to information

37. Information is an essential pillar for employing technologies for the provision of basic needs. Students and teachers in low-income communities, striving to keep abreast of the changing economic, political, social and technical configurations that affect their lives, require access to information. It is basic for activities geared to participatory action and movements to gain empowerment for poor populations. It is extremely useful
for smaller enterprises attempting to gain knowledge concerning how to go about applying for credit, possible product diversification, market conditions for their product, product specifications established by state regulations or by buyers, price and availability of inputs, transportation alternatives and schedules, and alternative techniques of production. Decision-makers must also be able to find out the extent to which resources intended to alleviate basic needs deficiencies are "hijacked" by income strata that are not really in dire need: programmes designed to alleviate poverty could be periodically reviewed so as to determine whether the targeted group is actually benefiting. While this is a national matter, non-governmental organizations are strategically placed to provide information on how much benefit is being reaped by the very poor.

38. There is a rich variety of media for sources of information that includes printed matter, telephones, radios, personal contact, and computers, for example. The central idea is to use all information avenues that are practical in the effort to increase the poor's exposure to information that is comprehendible and useful. As in the cases of education and small-scale economic activities, the scientific and technological community can be of great value by initiating participatory explorations with targeted groups to identify and facilitate access to such information. The information needs to be structured and intelligible to poor populations; the flows should not be unidirectional. The international community, donors, non-governmental organizations and state agencies all need to receive, process, analyse and share data collected at the local level on quality-of-life indicators, progress of development programmes, and new opportunities for, and challenges to, achieving further impetus to technical learning and improvement in regions characterized by low-income populations. Furthermore, the international community must take a leadership role in monitoring technological progress in those areas likely to yield benefits to poor communities.[33]

Participation

39. When poor populations are introduced to technologies, the chances for successful outcomes are improved markedly when the prospective users are directly involved in the process of selecting adequate technologies, properly adapting them to prevailing economic activities and conditions, disseminating the technologies among themselves, and mastering and improving on them. It is recommended that agents responsible for upgrading technologies and skills in poor communities build a strong participatory dimension into such programmes.[34]

40. Participation in a more general sense could have equally important beneficial effects with respect to low-income people's innovativeness, incentives to risk experiments with new technologies and their ability to recognize opportunities inherent in market-oriented national and international economies. When poor populations are politically impotent and socially marginalized, all of the foregoing attributes are severely diminished. The keys are political empowerment and greater social integration of poor populations; closely associated with these objectives is greater decentralization of government towards increased local decision-making. As one report on human development observed: "Greater people's participation has become an imperative, a condition of survival."[35] One of the most effective avenues for fostering participation by the poor is the decentralization of state functions, thus freeing, indeed obliging, local communities to engage in problem-solving activities and in the formulation and execution of development policies. It is important that Governments recognize the political, economic and social benefits flowing from decentralized governance, empowerment and social integration of poor populations and so implement actions supporting these objectives. Particular attention and special effort should be devoted to encouraging participation of both men and women. While a role is to be played by all levels of actors in achieving these objectives, the linchpin is the engagement of intermediate and fundamental non-governmental organizations that can assist local organizations in attempting to solve their own problems. This fits comfortably with the emphasis given by the World Summit for Social Development to the goal of social integration, on the agenda of its session to be held in Copenhagen in March 1995.

Health

41. Health is basic for being independent and becoming more productive, and for people taking direct responsibility for their own development. In fact, health, sanitary conditions and, accordingly, life expectancy are fundamental indicators of basic needs satisfaction. It is important to emphasize that health, together with education, housing and food, are determining factors of the social position of low-income populations. Health problems of these populations show a specific pattern related to deficiencies and hazards originating from poverty. Some one billion people live without adequate water and sanitation, and this is the cause of many of the most prevalent diseases in developing countries. Many health problems can be prevented, diagnosed and treated with available, relatively simple and affordable equipment, and work in the field of sanitation and waste management through promotion of technologies affordable by low-income communities, as well as that promoting technology development in vaccines and diagnostics is proving to be critical. HABITAT and UNIDO have been active in these fields.[36] At the same time, recent technology based on physical and engineering sciences has provided new health-care devices and techniques. However, many of these technologies are complex, costly and technically demanding, particularly for developing countries. Their effective introduction, use and maintenance requires sophisticated managerial, medical and engineering talent, and points to the need to evaluate health priorities and allocate scarce resources. In the specific context of basic needs, WHO's efforts to provide guidance on essential equipment for health facilities and to strengthen national capacities for the use of health technology as integrated components of overall health systems development are of particular importance. Such efforts require sustained support by all of the international community.

Basic infrastructure

42. Basic physical infrastructure constitutes another critical "pillar" supporting the bridge between basic needs deficiency and prosperity, providing an atmosphere in which innovative behaviour can be meaningful, and facilitating the attainment of necessary inputs and the marketing of products. Many of the methods for providing basic infrastructure are already on the "technology shelf"; it is mainly a question of giving infrastructure the priority and commitment that it deserves. Special attention should be directed to such considerations as ease of obtaining water and fuel. This for example can reduce or eliminate the burdens falling disproportionately on women. It is recommended that very high priority be accorded to the provision of basic infrastructure to poor populations. Clearly, in this area the responsibility often rests with the State, but donors, especially those supporting least developed countries, can be extremely helpful in influencing priorities. Since infrastructure is almost always construction-intensive, there may be scope for utilizing local resources including income-generating employment of unemployed or underemployed members of the local labour force. In this respect, local and regional agencies can serve a useful function. In addition, longer-term efforts might focus on feasibility studies investigating the viability of large-scale science-cum-engineering projects. More ambitious projects in this respect have included water diversion schemes.

Small-scale economic activities

43. Small-scale economic activities will, for the foreseeable future, constitute the primary source of employment and income for poor populations; this alone renders such activities critical in terms of the pillars of the bridge between unmet basic needs and prosperity. There is now ample evidence that small loans to low-income entrepreneurs starting or operating a micro and/or small enterprise can be made available on commercial terms or with a very modest subsidy. Governments without adequate methods for financial delivery to these enterprises could initiate such a programme after careful investigation of the experiences of countries with such mechanisms in place. The primary impetus must be at the national level, although international actors can be instrumental in conducting evaluative case-studies of credit delivery to low-income entrepreneurs in developing countries; non-governmental organizations might be useful as a conduit and screening agency between the centrally provided credit and the borrowers.

44. However unintentional, certain macroeconomic policies frequently have deleterious effects on both labour-intensive production techniques and smaller enterprises." Given the importance of the informal sector, Governments should consider ways to reduce antagonism between players in the informal sector, the formal sector and the State. Monetary and fiscal policies, as well as policies affecting trade, exchange rates, pricing, labour and wage regulations, can be biased against micro and small and medium-sized enterprises. Given this possibility, it may benefit nations with poor populations to examine systematically their policy framework and take measures to address any unwarranted disincentives to the promotion of the micro and small/medium-sized sector. Other aspects are also critical, particularly technical assistance, including assistance for identifying promising projects, preparing feasibility studies, organization and management of an enterprise, the process of selecting technologies and using them efficiently, quality control, means of transportation, and marketing. The advisability of regulatory provisions hampering the technical progress of enterprises in the informal sector should come under close critical scrutiny. While the national level is the prime mover, technical assistance from international agencies should be available as needed.

45. While all such measures could be implemented in fairly short order, in the long-run, however, technological progress is necessary, especially in emerging technologies amenable to achieving viable technology blends with traditional production methods. Particularly promising in this respect are: new biotechnological innovations that tend to be scale-neutral; new materials that

can be inputs for small manufacturers; nutritional enhancement of oral rehydration salts; new methods of direct casting and thin films for photovoltaics; long-range meteorological predictions of drought conditions; and information technologies suitable for poor communities. The international community could encourage research and development to promote such emerging technologies and conduct experiments leading to their integration with traditional, low-income, small-scale activities. In general, efforts concentrating on replicating programmes that work effectively to support micro and small/medium-sized enterprises could do a great deal to satisfy basic needs.

B. Summary recommendations for action

46. Despite the fact that the complete picture of poverty alleviation is complex, and though the accomplishment of the goal of alleviating poverty constitutes a serious challenge, the statement of the fundamental objective of the technological facet of the problem can be formulated very succinctly: **to create participatory conditions that increase the ability of the poor in the generation, access, comprehension and utilization of technology in order to satisfy their basic needs.** Clearly, there is considerable interaction and complementarity among all of the six bridging elements identified in the report and concerning technology and basic needs. It is highly desirable that these elements be introduced in concert rather than in isolation. Recommendations for action on these elements and on fundamental science and technology policy for addressing basic needs follow:

1. Education

(a) Considerable evidence attests to high rates of returns—both in monetary terms and in various indirect social benefits—accruing to expenditures on education. This is especially so for women and for primary basic education. It is therefore recommended that science- and technology-based education be considered a cornerstone of a strategy to meet basic needs.

(b) Although an entire range of curricula, topics, and emphases can be involved in the provision, the following should be considered essential to the cause of alleviating basic needs shortfalls: (i) education for increasing production and productivity of small-scale economic activities; (ii) education enabling the poor to relate to their environment and to participate effectively and constructively in community life; (iii) education enabling the poor to put into practice policies and programmes of preventive medicine that is indispensable for improving their levels of health and nutrition; (iv) education for the poor that will provide impetus to a process of sustainable development, one that will preserve and protect the environment.

(c) State-of-the-art technology-assisted education and vocational training should be seriously considered.

(d) Countries should be encouraged to review their expenditures on education in terms of the allocation between primary, secondary and higher education, geographic configuration and gender equity, in order to determine if the investment is consonant with optimal social returns and basic needs considerations.

(e) The United Nations should promote and sponsor a conference to sensitize the scientific and technological community and policy and decision-makers to the issue of the contribution of science and technology for the satisfaction of basic needs.

2. Access to information

(a) Information must be accessible by poor populations for general education purposes, to further participatory action leading to empowerment and to support small-scale enterprises attempting to gain knowledge concerning applications for credit, diversification of product, market conditions, product specification,

price and availability of inputs, transportation alternatives and schedules, and alternative production techniques. Efforts should also be made to assist the poor in accessing existing information sources in structured and intelligible forms that are useful for basic needs satisfaction.

(b) The scientific and technological community should be encouraged to initiate participatory exploration with targeted low-income groups in order to identify priority information needs and to facilitate access to such information.

(c) Through periodic review of basic needs programmes, decision-makers must get information on the incidence of "hijacking" whereby the non-poor are benefiting inordinately from such programmes while objectives related to filling basic needs deficits are not being met.

(d) The international community can make major contributions by collecting and disseminating information related to overall efforts to satisfy basic needs: (i) monitoring the most significant basic needs indicators for the world's poor populations; (ii) offering a "one- stop" referral service in information networks; (iii) providing monitoring and alerting mechanisms regarding new technological outputs that are particularly promising for satisfying basic needs.

3. Participation

(a) It is recommended that in technology-related projects geared towards bettering the lot of poor populations every effort be made to involve the target group fully at every stage.

(b) More generally, support for participatory actions leading to the empowerment of the ultra-poor to affect the political, economic and social aspects of their lives is justified for intrinsic reasons, and also because participatory-driven empowerment can create an atmosphere more conducive to innovative behaviour.

4. Health

(a) Countries should be encouraged to give greater emphasis to preventive *versus* curative health measures.

(b) Countries should review the geographic configuration and gender equity of their health programmes, in order to determine if the investment as constituted is consonant with optimal social returns and basic needs considerations.

5. Basic infrastructure

(a) Basic physical infrastructure is a requisite for supporting the other "pillars" of the bridge leading from poverty to prosperity. Primary responsibility rests with the State, but donors can also be effective in providing adequate supplies of safe water, energy, sewage and other sanitation facilities, transportation grids and means of communication.

(b) Since such basic infrastructure is often construction-intensive, every effort should be made to mobilize local resources, including income-generating employment, in the provision of facilities.

6. Small-scale economic activities

(a) Governments without adequate methods for financial delivery to micro/small and medium-sized enterprises should consider seriously the initiation of such a programme after careful perusal and consideration of the experiences of countries with such mechanisms in place.

(b) Often, however unintentional, macroeconomic policies can have deleterious effects on labour-intensive production techniques and/or smaller enterprises.

Therefore, it is recommended that nations undertake a meticulous and systematic review of each major component of their macroeconomic policy framework and take measures to address any unwarranted disincentives for a vital and progressive micro/small/medium-sized productive sector.

(c) Governments should recognize the contributions of the informal sector as a repository of employment, in generating income, and frequently, as a source of innovation. Means should be explored for technically upgrading informal activities, increasing "graduation" rates to the formal sector and reconciling frictions between the informal sector, formal sector and the State.

(d) The scientific and technological community should be encouraged to take the initiative in linking, in a participatory fashion, technologies with smaller-sized entrepreneurs.

7. The foundation: Recommendations for action concerning science and technology policy for basic needs

(a) In view of inadequate existing poverty programmes, new technological means for addressing basic needs, and the sweeping economic, political and social transformations in the global landscape, it is proposed that the United Nations adopt the issue of technology for basic needs as an agenda of concern. The United Nations should implement a mechanism for the evaluation of national science and technology policies with the aim of determining how adequately basic needs satisfaction is being addressed. Countries should be exhorted to build into their science and technology strategies a major component addressing basic needs.

(b) It is recommended that nations carefully and comprehensively survey existing technical assistance, extension services and other programmes that support technological upgrading of small- and medium-sized enterprises and adopt those that seem suitable to their own circumstances.

(c) Attention should be directed towards strengthening of networking of science and technology institutions and enterprises of both private and public sectors, at the national and international levels.

(d) A pilot programme should be developed for science and technology for basic needs, involving different countries from diverse regions. If this recommendation is accepted, the Commission on Science and Technology for Development should establish a Board on Technology and Basic Needs. The functions of the Board shall be to: (i) examine the overall approach and feasibility of implementing the programme; (ii) identify participating countries, formulate an operational programme and budget, and find the necessary financial resources for its implementation; and (iii) report on these activities to the Commission on Science and Technology for Development at its third session.

(e) It is recommended that technology for basic needs be addressed in a series of sessions involving participation by the Commission on Science and Technology for Development (CSTD). It is also recommended that a joint session of CSTD and the Commission on Human Rights be held.

Notes

1. See *Review of the Work of the United Nations System and Selected Organizations Dealing with Technologies for Basic Needs* (UNCTAD/DST/Misc.14-TECH/BASE/7).

2. See Frances Stewart, *Basic Needs in Developing Countries*, Baltimore, Maryland, the John Hopkins University Press, 1985.

3. See paper by S.L. Yampolsky, "Main Directions to Preserve and to Develop the Internal Scientific and Technological Potential in Ukraine - Vocational Training in Ukraine" (TECH/BASE/12).

4. UNCTAD, *The Least Developed Countries 1993-1994 Report*, New York and Geneva, United Nations, 1994.

5. United Nations, *Report on the World Social Situation 1993*, New York, United Nations, 1993.

6. *Ibid.*

7. Inter-American Development Bank and UNDP, *Reforma social y pobreza: Hacia una agenda integrada de desarollo* (in Spanish), Washington, DC, IDB, 1993.

8. World Bank, *Implementing the World Bank Strategy to Reduce Poverty*, Washington, DC, World Bank, 1993.

9. According to *The Economist*, "since 1979 real income of the poorest 10 per cent has fallen in real terms while average income of the whole population rose by 25 per cent and that for the top 10 per cent of the population expanded by 50 per cent", *The Economist*, 4 June, 1994.

10. See papers by: G. Yiemene, "Science and Technology Policy Initiatives to Address the Basic Needs of Low Income Population in Ethiopia" (TECH/BASE/13); M. Gbeassor, "Experiences in Togo" (TECH/BASE/10); and S.P. Kagoda, "Profiles of On-going Projects in Uganda which Attempt to Address the Needs of Low-income Populations" (TECH/BASE/11).

11. See paper by A. Ventura and M.E.D. Henry, "Technology for Basic Needs: the Forgotten Strategy" (TECH/BASE/17).

12. See also papers by O. Serrate, "Ciencia para el desarrollo humano sostenible, tecnologías para los derechos vitales" (in Spanish) (TECH/BASE/21) and "Science for Sustainable Development, Technologies for Vital Rights" (TECH/BASE/21/Add.1) (unedited version in English), and by G. Fernández, "Technology and Basic Needs: Notes for Policy Guidelines" (TECH/BASE/22).

13. See S. Lall, *et al*, 1994.

14. C. Maldonado and S.V. Sethuraman (eds.), *Technological Capability in the Informal Sector*, Geneva, International Labour Office, 1992.

15. See paper by Dilmus D. James, "Basic Needs - Old Imperatives - Fresh Approaches" (TECH/BASE/18).

16. The work that gave intermediate (later designated "appropriate") technology a strong following was that of E.F. Schumacher, *Small Is Beautiful: Economics as if People Mattered*, London: Blond and Briggs Ltd., 1973. For early reviews of appropriate technology, see, for example, H.W. Singer, *Technology for Basic Needs*, International Labour Office, 1972; UNIDO, *Conceptual and Policy Framework for Appropriate Industrial Technology. Monograph on Appropriate Industrial Technology*, No 1, 1979, and N. Jequier and

G. Blanc, *The World of Appropriate Technology*, Paris, OECD, 1983. The most exhaustive review and evaluation of the concept of appropriate technology is by K.W. Willoughby, *Technology Choice: A Critique of the Appropriate Technology Movement*, Boulder, Colorado, Westview, 1990. On the latter aspect, see also R. Bhagavan, *A Critique of "Appropriate" Technology for Underdeveloped Countries*, Uppsala, Sweden, The Scandinavian Institute of African Studies, 1979.

17. See paper by Mikoto Usui, "Newly Emerging Technologies for Blending with Traditional Technologies" (TECH/BASE/25 and Add.1).

18. See, for example, E.U. von Weizsacker, M.S. Swaminathan and A. Lemma (eds.), *New Frontiers in Technology Application: Integration of Emerging and Traditional Technologies*, Dublin, Tycooly International Publishers, 1983; A.S. Bhalla, D.D. James and Yvette Stevens (eds.), *Blending of New and Traditional Technologies: Case Studies*, Dublin: Tycooly International Publishers, 1984; A.S. Bhalla and D. James (eds.), *New Technologies and Development: Experiences in Technology Blending*, Boulder, Colorado, Lynne Rienner, 1988; and U. Colombo and K. Oshima (eds.), *Technology Blending: An Appropriate Response to Development*, London, Tycooly, 1989.

19. See D. James, *op cit.* Current technology blending efforts include the application of microelectronic innovations to traditional small-scale manufacturing in Latin America, "biovillage" and information village projects in India, a variety of projects being implemented in Malaysia, and the development of artificial intelligence software suitable to solving the problems and conditions of developing countries.

20. See Ajit Singh, *Basic Needs and Development Programme. Industrialization, Employment and Basic Needs in a Fast-growing Agrarian State: a Study of the Indian Punjab*, World Employment Programme Research, Working Papers, ILO, 1983.

21. See Ajit S. Bhalla and Amulya K.N. Reddy, *The Technological Transformation of Rural India* (a study prepared for the International Labour Office within the framework of the World Employment Programme), London, Intermediate Technology Publications, 1994.

22. In various case-studies contained in the volume referred to, it is recognized that markets and competition will increasingly provide a framework for more effectively organizing the production and distribution of these goods and services. A synthesis is required for fully harnessing the advantages of the market as a way of overcoming its limitations, for example equity-blindness, its environmental "externalities" and its preoccupations with the short term.

23. While a battery of policy measures had been in operation for nearly 40 years in India, the authors affirm that this had not led to rapid growth and technological transformation of the rural sector. A number of reasons explain this, including the fact that various measures took the form of hidden subsidies, which may have discouraged innovation. One of the primary objectives of the policy measures was social welfare and employment; thus, governmental policies had been much less development-oriented than desirable.

24. See H. Szretter, *Planning for Basic Needs in Latin America. Mexico: las necesidades básicas de alimentación*, Institute of Social Studies, ILO, PREALC, 1985.

25. Rudolf Teekens (ed.), *Theory and Policy Design for Basic Needs Planning: A Case-Study of Ecuador*, The Hague, 1988.

26. It is further stated that "in the case of milk and dairy products, small-scale rural industries may play an important role in rural income and employment generation, but modern small-scale and large-scale industries would be needed to provide adequate supplies of dairy products to satisfy a target level of domestic demand.... In other sectors, modern small-scale industry could function at an intermediate technology level where growth and employment objectives are reconciled. Such options exist in both basic consumer goods (e.g. processed meat, milking products, dairy products, clothing and shoes) and in intermediate goods industries (e.g. textiles, leather, wood, metal products)". R. Teekens (ed.), *op. cit.*, pp. 334-335.

27. Fernando Villarán de la Puente, *Innovaciones tecnológicas en la pequeña industria*, Lima, Fundación Friedrich Ebert, 1989 (in Spanish).

28. Within the context of the Technology Policy Group of the Junta del Acuerdo de Cartagena, and under the responsibility of Salazar de Buckle of the Andean Technological Development Projects, the final products resulting from this experience were commercialized under the name "Chicolac". See Gustavo Flores Guevara, "Transfer and Adaptation of a Technology of Milk Substitutes Production in the Andean Group: a Bolivian Case-study", in *Research and Development: Linkages to Production in Developing Countries*, Mary Pat Williams-Silveira (ed.), published in cooperation with the United Nations Centre for Science and Technology for Development, Boulder, Colorado and London, Westview Press, 1985.

29. See data cited in UNCTAD, *The Least Developed Countries, 1993-1944 Report*, New York and Geneva, United Nations, 1994, p. 126.

30. *Ibid.*, p. 127.

31. For example, about 40 per cent of personal income inequality in Brazil is related to education. See Jere R. Behrman, "Investing in Human Resources", in IDB, *Economic and Social Progress in Latin America: 1993 Report*, Washington, DC, IDB, 1993, pp. 187-255.

32. For an example of a successful urban delivery system in Ghana, see ILO, *Entrepreneurship and Small Enterprise Development in Urban and Rural Sectors in Africa*, Geneva, ILO, 1993; also, for a description of a more ambitious, experimental "biovillage" in India, see M.S. Swaminathan Foundation, *Third Annual Report. 1992-93*, Madras, the Foundation, 1993.

33. A great deal of the necessary information routinely appears in UNDP's annual *Human Development Report*. UNCTAD's *ATAS Bulletin* could devote an issue entirely to monitoring scientific and technological undertakings or outputs that hold significant promise for satisfying basic needs.

34. See, in this context, chapter III, section B, "Building a Commitment to Technological Change" in UNCTAD document *Transfer and Development of Technology in the Least Developed Countries: an Assessment of Major Policy Issues* (UNCTAD/ITP/TEC/12). From the case studies presented in this document, it would appear evident that planners and policy-makers in donor countries and host Governments at national, regional and local levels must deliberately encourage and facilitate such a participation process.

35. UNDP, *Human Development Report, 1993*, New York, Oxford University Press, 1993, p. 99.

36. See *Review of the Work of the United Nations System and Selected Organizations Dealing with Technologies for Basic Needs* (UNCTAD/DST/Misc.14-TECH/BASE/7), pp. 7, 14-16, 28-30.

37. See Frances Stewart (ed.), *Macro-policies for Appropriate Technology in Developing Countries*, Boulder, Colorado, Westview, 1987 and Frances Stewart, Henk Thomas and Ton de Wilde (eds.), *The Other Policies: The Influence of Politics on Technology Choice and Small Enterprise Development*, London, Intermediate Technology Publications, 1990.

ANNEX I

List of participants in the Panel on Technology for Small-scale Economic Activities to Address the Basic Needs of Low-income Populations

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Mr. Mussie Delelegn
First Secretary
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ANNEX II

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SUBSTANTIVE THEMES: (b) THE GENDER IMPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DEVELOPING COUNTRIES

Science and technology for sustainable human development: The gender dimension

Report of the Panel

Pursuant to Economic and Social Council resolution 1993/74, the Panel on the Gender Implications of Science and Technology for Developing Countries has completed its work. The report of the Panel is submitted to the Commission for its consideration.

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Executive summary

Objective:

To make recommendations to national Governments for individual country actions; and recommendations to Economic and Social Council for reforms required in the United Nations system on "gender, science and technology".

Process:

This report has been prepared by a working group of eight male commissioners and eight female advisors. They have been assisted by 20 consultants, and several women's non-governmental organizations (NGOs), and United Nations agencies. The process, described in the annex, has been highly consultative and participatory.

Key Findings:

(a) **Gender inequity in education and careers in science and technology**
There are serious obstacles to girls and women's participation in scientific and technical education and careers, and there are relatively few women in science and technology decision-making bodies and advisory boards.

(b) **The gender-specific nature of technical change**
Technical change aimed at benefiting people in rural areas in developing countries appears to have benefited men's lives more than women's lives.

The premise that development is gender specific underpinned the analysis of the Gender Working Group. That is, women and men have different roles and responsibilities and perform different tasks. To ensure that science and technology benefits all members of society, attention must be paid to the respective needs and interests of men and women equitably.

Seven issues on which "**Transformative Actions**" are both necessary and feasible were defined, and lists of possible actions were identified. The seven issues were:

- Gender equity in science and technology education
- Removing the obstacles to women in scientific and technological careers
- Making science responsive to the needs of society: the gender dimension
- Making science and technology decision-making more gender aware
- Relating better with local knowledge systems
- Addressing ethical issues in science and technology: The gender dimension
- Improving the collection of gender disaggregated data for policy makers

A "**declaration of intent**" consisting of six goals for equity in science and technology was formulated and all Governments are invited to subscribe to this declaration and to establish an ad hoc committee to formulate national action plans for its implementation.

The United Nations Review:

An extensive review of the performance of the United Nations system in gender, science and technology resulted in a set of recommendations for transmission to the Economic and Social Council.

INTRODUCTION

1. At its first session in 1993, the United Nations Commission on Science and Technology for Development agreed on criteria for selecting topics for its second session in 1995. One of the criteria agreed on was to address science and technology components of major United Nations Conferences to be held in 1995. The Fourth World Conference on Women and Development to be held in Beijing, China, was such an example. Consequently, the Commission chose "Gender, Science, Technology and Sustainable Human Development" as one of the three topics for its second session. This report, which is an input to the Commission's deliberations, has been prepared by the Gender Working Group consisting of eight women and eight men. They were assisted by 20 consultants who prepared expert papers, and by many non-governmental organizations active in gender, science and technology, along with individuals, academics and United Nations agencies. Three-quarters of the Gender Working Group were from developing countries. (See annex for information on the method of work.)

2. The remit of the Panel on Gender Implications of Science and Technology for Developing Countries, hereafter referred to as the Gender Working Group, is defined by the area of overlap of three domains: science and technology; sustainable human development; and gender. This overlap has not been deeply explored in the past. Before turning to the results of the Gender Working Group's analysis, it is first necessary to identify some of the essential elements of these three domains. This enables us to identify the common perspectives shared by all members of the Gender Working Group and provides the basis for the diagnosis and prescriptions presented in subsequent chapters.

3. With regard first to "science and technology", a distinction was made between the development, diffusion and utilization of modern science-based technologies and local knowledge and traditional technologies that had evolved over many years of trial and error within communities. Both knowledge systems are important for sustainable human development, but the science-based technologies have formed the basis for industrialization in the more developed countries over the past 100 years. Those developing countries that have invested in their own modern scientific and technical capabilities have been able to join the industrialization process. Several East Asian countries have experienced remarkable economic growth rates over the past 20 years by relying on this strategy.

4. Developing countries that have not been able to make comparable investments in their own scientific and technical capabilities have not shared in these advances. Current globalization trends are rendering these countries increasingly marginalized. There now exists a wide spectrum of developing countries, ranging from those with little capability in science and technology which are all but excluded from the global economy, to those with advanced capabilities and whose economic growth rates are out-stripping many of the older developed countries.

5. It is not only in economic growth and wealth creation that science-based technologies have made substantial contributions. Major transformations in agricultural practices have also been made possible by new technologies. Perhaps most dramatic has been the contribution of modern science to health and the eradication and amelioration of diseases and improvement in world-wide health care.

6. The impact of science and technology on society has not been uniformly beneficial. Not all members of society have shared in the benefits; the development of weapons of mass destruction and growing pollution and environmental degradation are the reverse side of the coin. Likewise, social problems of alienation, unemployment and increased crime, often seem to follow in the wake of technical change. Technological changes, for good or for ill, do not automatically spring from the results of scientific research. They are a consequence of countless decisions made by scientists, engineers, corporations and Governments, which collectively dictate the impact of science and technology on the lives of everyone. It must become an objective

of science and technology policy to maximize the benefits to be derived from science and technology, and to minimize its harmful effects for all members of society. This objective underlies the approach to examining the gender dimension of science and technology.

7. The second domain of analysis is that of "sustainable human development". This is the dimension of development that emphasizes people rather than economic growth *per se*. It seeks to improve the quality of life of all people today without harming the prospects of future generations. This concept has been elaborated by United Nations Development Programme (UNDP) in successive human development reports and it is the type of development to which the Gender Working Group subscribes.

> **"Sustainable human development should join sustainable development and human development every day, in practice, on the ground around the world. It is development that does not merely generate growth, but distributes its benefits equitably; it regenerates the environment rather than destroying it; it empowers people rather than marginalizing them; it enlarges their choices and opportunities and provides for peoples' participation in decisions affecting their lives. Sustainable human development is development pro-poor, pro-nature, pro-jobs, and pro-women. It stresses growth with employment, growth with environment, growth with empowerment, growth with equity."**[1]

8. The third domain is that of "gender". The Gender Working Group accepted the conclusions of previous studies that had demonstrated that development itself is gender-specific. Gender refers to the distinct roles that men and women are assigned in any society. As a result, women and men tend to assume distinct socially and culturally defined responsibilities and tasks both within the household and in the wider community. The knowledge and experience gained from undertaking these tasks, as well as their requirements, lead women and men to have different needs and aspirations. This concept of gender differentiation underpins the conviction that "science and technology for development" must systematically and purposefully recognize the gender-specific nature of development and respond to the concerns, needs and aspirations of both women and men appropriately and equitably.

9. Not only is development itself gender-specific, but all studies point to the fact that women are among the poorest of the poor, and are notably disadvantaged. In the words of the 1993 United Nations Development Programme Human Development Report:

> ***"In industrialized countries, gender discrimination is mainly in employment and wages, with women often getting less than 2/3rds of the employment opportunities and about 1/2 of the earnings of men. In developing countries, the great disparities, besides those in the job market are in health care, nutritional support and education. For instance, women make up 2/3rds of the illiterate population. South and East Asia, defying the normal biological result that women live longer than men, have more men than women. The reasons: high maternal mortality and infanticide and the nutritional neglect of the girl child."***[2]

10. Within the area defined by the overlap of these three domains, the Gender Working Group was asked to make science and technology policy recommendations to national Governments; to review the performance of the United Nations system and suggest improvements; and to provide advice to "other relevant organizations". In attempting to fulfil its mandate, the Gender Working Group was hindered by the paucity of available data. The data which do exist strongly suggest that in the area of concern, women are more disadvantaged than men. More attention must be paid in the future to the collection of data on (a) "participation rates of women" in science and related decision-making bodies and (b) the "differential impact of technical change" on the lives of men and women. Incidentally, on this latter point, there is substantially more data available on the impact of science and technology on the lives of poor women than on the lives of poor men.

11. Particular attention was paid to the gender dimension of science and technology for basic needs in developing countries. It was hoped that this approach would complement the recommendations of the Panel on Technology for Small-scale Economic Activities to address the basic needs of low-income populations. It became apparent, however, that the fundamental issues were germane to all countries. They often differed between countries only in context, scale and scope. Thus, although the primary focus of this report is on transformative actions for developing countries, it ends with a challenge to all Governments to sign a "declaration of intent" in support of a set of principles which the Gender Working Group believes should underlie every country's approach to gender and science and technology for development.

I. THE DIAGNOSIS

12. At the close of the twentieth century, women in the rural areas of developing countries are still experiencing serious difficulty in meeting their own basic needs and those of their households. Scientific and technological interventions have improved many aspects of women's lives, contributing to important declines in both maternal and infant mortality. However, over the last three decades, women in the developing countries have also become disproportionately poor in relation to men in their own communities. Several recent United Nations reports have documented women's differential poverty as a significant phenomenon requiring policy attention and intervention. This well-defined world-wide disparity between men and women cannot be understood without explicit reference to the gender-specific nature of development, including scientific and technological contributions to the development process.

Box 1

The United Republic of Tanzania prepares a "gender sensitive environmental policy"

The poverty of women in rural areas is demonstrated in the United Republic of Tanzania, where land, cattle and property are owned and inherited by men. Land allocations are made to heads of households who are usually men. Women are additionally handicapped by their limited access to education and even more limited access to modern technologies. Wood for fuelwood provides 95 per cent of the domestic energy used for cooking by both rural and a majority of urban dwellers. Fuelwood is also used in such agriculture-related activities as tea processing and fish smoking and in small-scale industries like pottery and blacksmithing. Shortage of fuelwood means that many women spend 5 to 8 hours per day collecting it.

The demand for fuelwood, coupled with agricultural clearance, timber harvesting, over-grazing, and cultivation of marginal lands has led to increased erosion and desertification, loss of biodiversity and increased prevalence of water pollution. This has a more severe impact on women than men. As a result, a "national environment policy" is being formulated to make development sustainable. The objective is to benefit men and women equally as key players in national resource management and conservation. The objective is to devise a gender-sensitive policy for the environment that recognizes the gender-specific nature of development and the different roles and responsibilities of women and men.

13. The present report focuses primarily on the basic needs of men and women in rural areas in developing countries. This is where most of the poorest people live and where there is strong evidence, collected over the past 20 years, that development itself is gender-specific. It was recognized that gender is also a component of science and technology issues in the urban

areas of developing and developed countries. While some reference is made to these issues, they have not been explored as fully as basic needs in rural areas. To assist the Gender Working Group with its analysis, background papers were commissioned from leading experts to diagnose ways in which science and technology have differentially affected the lives of men and women in various key sectors. The sectors include environment, health, agriculture, energy, information, education, employment, small and medium-sized enterprises, and indigenous knowledge systems.

14. Two main conclusions have been drawn from the evidence presented in the background papers:

(a) **Gender inequity in education and careers in science and technology**

- In most developing countries, there are serious obstacles to girls and women receiving an education in science and technology and in pursuing scientific and technical careers. Similar obstacles also exist for women in developed countries, particularly with regard to advanced science and technology training and education. These obstacles, which extend beyond those faced by boys and men, prevent women from fully contributing to advances in science and technology, including ones that could better meet women's basic needs and support their hopes and aspirations for the future.

(b) **The gender-specific nature of technical change**

(i) Technical changes aimed at benefiting people in rural areas in developing countries have, in fact, tended to benefit men more than women. This is because science and technology programmes have not explicitly recognized the gender-specific nature of development. As a result, technical changes offered to women have often been inappropriately formulated and designed.

(ii) Although women in the rural areas of developing countries have the most significant difficulties in meeting their basic needs, in urban areas women are also poorer than men and are likewise affected differentially by technical change.

These conclusions are elaborated further below.

A. Gender inequity in education and careers in science and technology

15. More girls remain marginalized from the mainstream of education than boys. Girls do not enjoy equal access to a formal education. Outside the education system, the disparity between women and men in terms of literacy and access to science and technology training is pronounced. Among girls who do gain entry to school, fewer study science and fewer advance to high levels in science and technology where women are clearly under-represented. Girls and women are disadvantaged compared with boys and men both in acquiring a scientific and technical education and in entering and staying in scientific and technical careers. This conclusion is not new.

16. A recent series of national government task forces, regional workshops on gender in science and technology and international reviews[1] have analyzed the evidence and reached similar conclusions. Many of the observations made about education and careers apply to all countries, although some aspects are culture and country specific. All agree that in most developing countries:

- Cultural attitudes and gender stereotyping are obstacles to education and careers for girls and women;

- More boys than girls receive a basic education;

- Among those who receive an education, more boys than girls study science and technology;

- There are more men than women in scientific and technical careers;

- There are very few women in science and technology policy - and decision-making positions, or on advisory boards.

17. Some of these conclusions are demonstrated graphically in the accompanying figures. Figure 1 is particularly interesting as it demonstrates that there have been substantial improvements in the gender balance of students studying science and technology subjects in tertiary education in many regions of the world. The exceptions are Africa, where the ratio of women to men has remained at around 10 per cent over the last twenty years, and eastern Europe where the ratio has declined over the past ten years. Figures 2 and 3 illustrate the wide range in terms of the gender balance within scientific and technological careers from one country to another.

18. There are compelling reasons to create policy and institutional environments which foster and promote gender equity in education and careers and decision making in science and technology. Beyond the moral force of fairness there is also the need for countries to succeed in the global marketplace. Governments of developed and developing nations alike recognize the need to maximize the creativity and ingenuity of all available human resources. Marginalization of one-half of the pool of national talent does not make good sense.

19. The Gender Working Group explored the reasons why there is such pronounced under-representation of girls in technical education and women in scientific careers. Although there is considerable variation between countries and cultures, and despite improvements in some countries over the past twenty years, there nevertheless appears to be a set of common characteristics which contribute to the persistent under-representation of women in science.

20. The Gender Working Group identified a range of factors that serve to mitigate against young girls gaining access to the school system and pursuing a science and technology stream, including:

- Social conditioning and gender stereotyping particularly of young children world-wide;

- Lack of national government resources to support education for all, and in some cultures, a national bias favouring the education of boys over the education of girls;

- Parental preference favouring the education of boys over girls owing to cultural reasons and economic constraints which result in young girls assuming family and household responsibilities early in their lives;

- The misleading perception of parents, some teachers and guidance counsellors that science and mathematics are "difficult subjects" and not as suitable for girls as for boys;

- Curricula and textbooks that do not relate science to everyday experiences of both boys and girls, contain gender-biased language and which fail to give due recognition to the contributions to women scientists or promote women role models for girls;

- The fact that in some countries, girls' schools are not as well equipped with laboratories and equipment as are boys' schools.

21. Among the many factors that explain why women are under-represented in scientific careers are:

- The challenge of combining family responsibilities with professional careers where household responsibilities are not equitably shared;

- The pace at which science advances makes it difficult to re-enter a scientific career once it is interrupted to raise a family or for other reasons;

- The difficulty of breaking into the formal and informal scientific networks that characterize the workings of the scientific community and which have been largely male dominated.

- The reluctance of some employers to invest in the training of women owing to the perceived likelihood of their leaving the organization to raise a family.

Box 2

Breaking the isolation
- Building networks of support for women in science -

One of the most frequently cited factors creating a "chilly climate" in the sciences for professional women is their "isolation" in a male-dominated domain. Efforts to bridge this isolation and provide peer support have led to the formation of several regional and global networks by creative non-governmental organizations in the last decade. Examples include a student's electronic network connecting women studying computer sciences; the Third World Organization for Women in Science (TWOWS), the Forum for African Women Educationalists, the Gender, Science and Development network of the International Federation of Institutes for Advanced Studies, Canada (IFIAS), the World Women's Veterinary Association (WWVA), Women Inventor's Association, Gender and Science and Technology (GASAT), Women in Science and Engineering (WISE), Women in Science and Technology Development through APPROTECH-Asia, Women in Science Enquiry Network (WISENET), and the Pan-African Women Engineers Technicians and Scientists (PAWETS) network.

PAWETS, for example, was founded at the International Congress on Women Engineers and Scientists in 1987 by the Ugandan member of the Commission on Science and Technology for Development Advisory Board to the Gender Working Group. It links associations of women engineers, scientists and technicians in Africa. PAWETS promotes the participation of girls and women in science and technology education and training with the goal of increasing African girls and women's scientific literacy. Career guidance materials are developed for national associations to use in country-specific campaigns. Career re-entry support programmes are also supported. A regional seminar, organized by PAWETS and sponsored by UNESCO, recently advanced recommendations to Governments, the Organization of African Unity (OAU), non-governmental organizations, and science and technology centres.

B. The gender-specific impact of technical change

The rural impact

22. The conclusion regarding the impact of technical change in rural areas has been drawn from the analysis of the commissioned papers. Although some members of the Gender Working Group considered them firm conclusions, others viewed them as hypotheses that required further testing.

(a) The potential of science and technology to effect changes in the lives of rural women and meet their basic needs has not been fully realized.

Box 3

Off the Shore and into the boats and boardrooms
- women in the fishing industry in Mexico -

The fishing industry in Mexico has been traditionally a male preserve. Women have been excluded "technologically" from access to the benefits of the full set of activities in the cycle of fishery production. For example, in the tuna and shrimp industry, the cycle starts with large vessels and netting technologies designed for men and requiring strong muscles to operate.

Only recently, through research promoted by the female minister of fisheries, has attention been paid to the development of fisheries technologies to enable women to participate fully in all aspects of the industry -- navigating vessels, managing the catch, transporting, processing and marketing. Through these newer technological developments, women as well as men can now participate in the full cycle of value added activities. Creating accessible technologies has allowed women to achieve real economic recognition for their work. Furthermore, once active in all aspects of the sector, women with practical experience can also assume more prominent positions in the bodies that set policy for the industry.

(b) Most science and technology programmes oriented toward addressing basic needs in rural areas of developing countries have failed to recognize the gender-specific nature of development.

(c) Most technical change appears to have been oriented to the tasks that men perform and to men's interests and needs in the development process.

Box 4

The differential impact of technical change in poultry and dairy farming in Egypt

In Egypt, poultry and dairy production had been solely the responsibility of rural women. New large-scale farming technologies and methods were introduced for poultry and dairy production which displaced the women farmers. The result: women and their families in rural areas were impoverished and men from outside the villages benefited. If smaller scale technologies had been introduced and the women trained to use them, the benefits would have accrued to the women's families and the villages.

(d) Although some technical advances clearly benefit society as a whole, other scientific and technological activities may cause harm for some groups of people or some aspects of the natural environment. Individuals may lose income, jobs or status. There may be unwanted environmental impacts, such as the spread of pollution or toxic contamination. Women have been differentially and, in many cases, more adversely affected by negative consequences in the sectors investigated by the Gender Working Group.

Box 5

Women and health: Selected research implications

The role of women differs from that of men as providers and receivers of health care. The health issues and concerns of women over a complete life-cycle differ significantly from those of men. Women carry most of the responsibility for reproduction and family maintenance; they are the central care-givers for children and the elderly in the household and community and thus are pivotal instruments in terms of the health of three generations.

Medical research related to women in developing countries has focused mostly on reproductive biology. As this is an important issue, more research is needed on its biomedical, clinical, epidemiological and social science aspects so as to strengthen reproductive health services. However, these are not the only health problems faced by women in developing countries. Additional research must be aimed at other issues that affect women throughout their lives. Women seem particularly susceptible to some diseases owing to their exposure to pollutants in the natural environment and their specific physiological susceptibility and responses to pollutants.

(e) A substantial amount of local traditional knowledge is held by women: in agriculture, environmental resource management and in health. This knowledge is often not the same as that held by men in the same areas. There is a need to find more effective ways to recognize the value of this gender-specific knowledge and to integrate it with modern science and technology for sustainable development.

Box 6

Integrating "modern" and "indigenous" knowledge systems for more sustainable community development

Community-based knowledge and technologies may lack a detailed theoretical base, but still provide a valuable and practical community focus on subsistence strategies, particularly with respect to agriculture, nutrition, health, sanitation and housing. Community-based knowledge systems are usually decentralized and depend upon human resources and ingenuity rather than external funding. The spread of such knowledge is almost always informal and based on oral history. Changes brought about in this system tend to be incremental in nature. Women are major, if not predominant innovators of technology and users of indigenous or local knowledge.

In contrast, institutional science derives its methods and intellectual foundation from seventeenth century Europe and has developed synergistically with industrialization. The "institutionalized science system" is highly centralized, hierarchical and dominated by men with several years of specialized formal education. The system is heavily financed by public and private funding. Progress is typified by radical discovery breakthroughs; intellectual property rights are recognized and well-protected.[4]

A successful example of development initiatives aimed at integrating modern and traditional knowledge systems is the case of "Bean Breeding in Rwanda". Initiated by CGIAR, scientists from the Centro International de Agricultura Tropical (CIAT), and the Institut des Sciences Agronomiques du Rwanda (ISAR) had collaborated with local women experts in the testing of improved bean varieties. This research has broken conventional patterns of relations between agricultural research centres and farmers and provided a model for other similar work by national programmes and international agricultural research centres.[5]

The urban impact

23. The only aspect of sustainable development in urban areas examined was income generation and employment. Within these sectors, the main focus was on the employment impact of new technologies, especially information technology. The main conclusion to be derived from this study was that:

- The new information technologies have increased employment opportunities for women, especially in service-sector occupations such as banking and finance. However, the new technologies have also made many existing jobs in manufacturing redundant or obsolete. These changes have affected men and women differently, but overall female labour has been displaced more than male labour. New jobs are more skill-intensive than old ones, and women have been at a disadvantage because of limited training opportunities compared with men.

Box 7

"Teleworking": boon or bain?

One of the expected advantages of information technology was the opportunity that it could provide for "teleworking" from home. Telecommunications technology offers the potential advantage of flexible working hours, and the possibility of combining child care with income generation. It has been found, however, that the disadvantages may exceed the advantages. The social and professional benefits of working with others are foregone and without a dedicated work space, family responsibilities may intrude and the perceived advantages may be ephemeral. Other problems of working at home include isolation of workers who tend to be hired part-time, on a casual contractual basis with few fringe benefits, little job security, and no pension plan. "Tele-cottages" (or technologically equipped spaces), where people can work close to homes, yet be in contact with other workers and have dedicated workspace and equipment would pose fewer disadvantages.

24. Most studies of women's needs and aspirations identify income generation as fundamental. This has led to increased interest in the role of women as entrepreneurs in small and medium-sized enterprises in the formal sector, and in micro-enterprises in the informal sector. Efforts are being made to encourage and facilitate women's participation in such enterprises. Most factors that facilitate this participation are not related to either science or technology but they have more to do with access to credit and other necessary resources. However, technical and managerial training and access to both local and new technologies, including information and technology management and marketing training, are important factors influencing the success of these enterprises.

Box 8

Information Technologies
Powerful tools of transformation in the informal sector

Computer-aided small-scale management and accounting systems have been found to improve business efficiency of women working as street vendors, garment pickers and tailors in the informal sector. The self Employed Women's Association (SEWA) in India is an example of an active non-governmental organization that works with women to make modern technologies for business efficiency accessible to those groups that are normally excluded from the benefits of modern science and technology.

25. Analysis of the impact of technical change on the lives of men and women has shown that it is differential. Sometimes men benefit; other times women benefit. The implication is that a "gender impact analysis" should accompany the development of all new technologies to identify the nature of the differential impact. This would enable supportive policies to be introduced to mitigate any negative impacts on the disadvantaged parties.

Box 9

National campaigns help remove barriers for women's scientific and technical training - cases from China and Botswana -

In 1989, the All China Federation of Women in cooperation with 12 organizations from central government launched a campaign for literacy and technical training for rural women. Along with reading and writing programmes, agricultural and forestry and commerce authorities promoted the establishment of rural enterprises for income generation and production centres. In the course of five years, some 27 million rural women have received technical training and 10 million benefited from the literacy campaign. Some measure of the success of the programme became apparent when many husbands began asking if they could join the training programmes. The technical training for women gave them new skills - some were reported to have said "**science and technology have given us golden wings**".

Other national Governments have launched creative science and technology programs targeted to remove barriers for girls and women in science and technology. One notable example is the *Girls and Women in Science: Science and Technology Roadshow* co-sponsored by the Government of Botswana and the Commonwealth Secretariat as an initiative of the 1989 Conference of the Commonwealth Ministers of Education. The Roadshow, moving from city to city, targets secondary school students, parents, teachers, employers and the public. It is sponsored by local contributions from several sources including hospitals, airlines, universities, private companies and vehicle repair shops as well as local embassies and UNESCO. The Roadshow designed its own slogan and logo for radio and print media releases and builds on enthusiastic local volunteers in each town visited. The Roadshow contains a series of components including role model videos, career guidance clinics, skill-building workshops, essay competitions and a newsletter **Women Make It.**[6]

26. If the objective of science and technology policy is to maximize the benefits from science and technology for all members of society, then ethical considerations must be part of the policy process. This is especially true for gender related issues, which often cut across the rural-urban and the developing-developed divides. Specific examples in the health sector include the application of such technologies as amniocentesis and ultrasound to determine foetal sex for the purpose of selective abortion of the girl child. Another example is the testing of drugs on third world women without their informed consent. These examples underline the need for both the scientific community and governments to develop ethical guidelines for the conduct of research and the application of research results, with particular emphasis on the gender dimension.

II. TRANSFORMATIVE ACTIONS

27. Authors of the background papers commissioned for this report were invited to identify recommendations for change within their sector. As a result, many ideas and recommendations contained in each of the papers will appear in extenso report in the publication entitled *Equity, Knowledge and Empowerment.*[7] The attention of Governments, non-governmental organizations and the scientific community is drawn to this book and its rich store of information and ideas. Drawing on this rich pool of resources, the Gender Working Group sought to identify seven key issues of particular relevance to all countries on which action was both necessary and feasible.

28. Each issue is first stated below, then policy and programme options are outlined for the consideration of Governments and science and technology bodies and agencies.

29. It has not been possible to estimate the costs of implementation. Some will be easy and cost little to implement; others may take a long time and be expensive. Each country would have to determine its own priorities and implement what it can within its means.

Box 10

Issue 1 **Gender equity in science and technology education**

Fewer girls than boys are given the opportunity to obtain formal education. Of the girls who do gain access to schools, a smaller proportion than boys obtain training in science and technology. This limits girls and women's opportunities: to meet their basic needs and improve the quality of their lives and those of their families; gain access to employment; create businesses; and acquire skills for citizenship. It also deprives nations of the contribution of many highly talented citizens. The extra barriers and obstacles confronting girls who seek training in science and technology subjects must be removed.

Transformative actions:

Equity in gaining access:

- Provide the same opportunities for access to formal education for both girls and boys.

Equality of opportunity within schools:

- Ensure literacy and basic instruction in science and technology for both boys and girls.
- Ensure that infrastructure, laboratories, and equipment in schools are equally available to girls and boys.
- Ensure that teaching materials in science and technology are sensitive to gender concerns in terms of language and illustrations. Where possible, these materials should also illustrate the link between the subject matter and everyday lives of girls and boys.
- The teaching of science should be broadened to include elements addressing the economic, social and ethical implications of science and technology.
- Recognize the importance of mentors and role models by women science teachers and provide rewards to those who devote substantial time to this activity.

Opportunity for distance education and re-entry to schools:

- Provide multiple opportunities for re-entering school, especially for young mothers (in some cultures, early marriage and teenage pregnancy are major reasons for girls leaving school).
- Introduce education programmes with flexible locations and times to enable more students, especially girls, to acquire scientific literacy.
- Introduce new approaches to science and technology education such as distance learning, making optimal use of both old (radio) and new (multimedia) technologies.

Box 11

Issue 2 Removing obstacles to women in scientific and technological careers

In many countries, there are few women in scientific and technological careers. In addition to considerations of equity no country can afford to lose up to one-half of its pool of creative and innovative human resources. The obstacles to greater participation of women in scientific and technical careers need to be addressed and overcome.

Transformative actions:

- **Specific measures for all employers:**

  Recent national government task forces and reports[34] have explored options for removing barriers to women in science and technology careers. These include general policies and those that support the professional, personal and family needs of all employees and ensure that the employees are able to balance family responsibilities with professional ones and career development, such as:

  - Alternative work arrangements such as flexible hours, flexible locations, and job-sharing opportunities; and commitment to on-site child care facilities;

  - Maternity and paternity leave policies; hiring and promotion criteria and processes to allow for family responsibilities to be assumed so that maternity, paternity and parental leaves do not jeopardize career progression;

  - Commitment to the hiring, promotion and career development of women in science and technology while adhering to the merit principle;

  - Policies against discrimination and harassment in the workplace.

- **Policy tools for Governments:**

  Tax relief for payment of child-minders; pay equity legislation; legislation against discrimination; directives for collection of gender disaggregated statistics; establishment of focal points for advice on gender in science and technology; an increase in the number of women appointed to policy advisory and decision-making bodies.

- **Initiatives in academia and the school system:**

  Establish networks of female professionals in science and engineering; enhance mentoring, role-model, and career advisory programmes; provide flexible tenure criteria to accommodate family roles and responsibilities; and provide refresher courses, and re-entry scholarships for women returning to careers in science.

Box 12

Issue 3 Making science responsive to the needs of society: the gender dimension

Most professionals working in science and technology are insufficiently aware of the needs of their society and the impact of their work on these needs. Likewise, citizens are insufficiently aware of the positive potential of science and technology to meet these needs. In particular, the gender-specific nature of the needs and the differential impact of science and technology on the lives of men and women are inadequately recognized by either science and technology professionals or citizens.

Transformative actions:

- Improve the decision-making mechanisms within the science system to ensure clear articulation of the gender-specific needs and goals of society by incorporating end-user opinions, both those of women and men. Use decision-making techniques, such as technology assessment and decision framework analysis, that make explicit the gender implications of the decisions taken.

- Encourage political parties and Governments to be more explicit in their policy platforms about how they intend to use "science and technology" to meet the basic needs of both men and women equitably in society.

- Encourage public media to sponsor popular science programming, including reports on the potential of science to serve goals of society and the basic needs of people; promote reporting on the impact of science on people's lives and, in particular the disparate impact of science and technology on men and women.

- Support non-governmental organizations working at the interface of gender in science and technology for development.

Box 13

Issue 4 Making the science and technology decision-making process more "gender aware"

Current structures and processes for decision-making in science and technology for development do not systematically take into account the needs and aspirations of both women and men in a manner that is gender disaggregated. Women's needs and interests have been relatively neglected.

Transformative actions:

- Increase the number of women in science and technology decision-making and policy advisory bodies. Set targets for representation in these bodies, with time horizons and strategies to ensure adherence.

- Establish databases of professional women so as to provide institutions with a pool of names of qualified women to be considered for appointment to policy and advisory bodies.

- Increase the understanding of all decision-makers about the gender implications of their decisions through explicit training programmes.

- Involve end-users, men and women equally, in the determination of research priorities and in the design and implementation of technology and development programmes. This will require explicit attention to the participation of women.

- Subject all development programmes with a high science and technology component to "gender impact analysis" before initiation. Gender analysis should be included in the design and the subsequent monitoring and evaluation. Technology assessment techniques and the decision framework should incorporate a gender dimension.

- Governments should establish a focal point of expertise in gender, science and technology to be available to advise government departments, facilitate training sessions, and monitor and report on the implementation of government strategies regarding gender, science and technology.

Box 14

Issue 5 Links with "local knowledge systems"

Modern science and technology has inadequately addressed the potential of local knowledge systems, especially women's knowledge, in the design and implementation of development programmes. There is a need to develop new methods of interaction between the two systems for their mutual benefit. Local knowledge is frequently not recorded and is in danger of being lost.

Transformative actions:

- Ensure the preservation of local knowledge systems with attention to their gender-specific nature.
- Development agencies should give full consideration to the contributions of local knowledge systems, giving particular recognition to the gender-specific nature of these systems.
- Make greater efforts to find creative ways to promote mutually beneficial exchanges between modern and traditional knowledge systems and technologies for the benefit of both women and men in rural areas.
- Bodies engaged in the study and promotion of intellectual property rights should address the capability of the present system to protect local knowledge owned by communities, paying special attention to its gender-specific nature. When external agencies exploit this knowledge for commercial gain, mechanisms should be found for compensating the men and/or women in communities where the knowledge originated.

Box 15

Issue 6 Addressing ethical issues in science and technology: the gender dimension

Ethical issues associated with both the conduct of scientific research and the application of the results of research frequently have a gender dimension which has not been sufficiently recognized or addressed.

Transformative actions:

- National and international scientific organizations - both governmental and non-governmental, should develop international conventions, declarations or ethical codes of conduct to provide clear boundaries of acceptable practice both in research and in applications pertaining to their fields of responsibility. These should be widely promulgated.

- National Governments should consider whether legislation is needed to enforce adherence to these codes of conduct. The use of technical procedures to identify foetal sex when the purpose is to abort the girl child is a case where some national Governments have taken action to legislate the boundaries of unacceptable practice. Other examples include testing of drugs on underprivileged groups, particularly women; the exploitation of local knowledge for commercial gain by outside organizations without appropriate acknowledgement and compensation.

- In determining the ethical issues on which guidelines and codes of conduct are to be developed, there should be wide consultation and involvement of stake-holders and end-users.

Box 16

Issue 7 Improving the collection of gender disaggregated data for policy makers

There is a paucity of data available at the national and international levels on participation rates of men and women in scientific and technological education and careers. There still is no systematic approach or coordinated method for ensuring the collection of gender-disaggregated data on science and technology. Of equal importance to policy-makers is the unavailability of data on the differential impact of technical change on men and women's lives.

Transformative actions:

- An international meeting of statisticians, along with science, technology, and gender specialists from national and international bodies should be convened by the United Nations (possibly UNESCO) to identify the critical statistics necessary for policy purposes; to designate responsibility centres; and to establish mechanisms for coordination and collaboration. Methods and common approaches should be decided on to permit cross-cultural comparisons over time and to ensure the best use of resources.

- National Governments and the United Nations system should revise statistics data-collection methods to ensure gender-disaggregated statistics are systematically and regularly collected both on participation rates and on differential impact; these bodies should coordinate efforts to ensure the collection of complementary sets of data, using common methods.

- Data collected by national Governments should be made available to both local and international bodies to ensure their maximum use in policy and programme formulation and to ensure their aggregation at the regional and international levels.

- Scientific bodies, universities, and academies should also collect relevant gender-disaggregated data.

III. PERFORMANCE OF THE UNITED NATIONS SYSTEM

30. The Gender Working Group was asked to review the performance of United Nations agencies in the domain of gender, science and technology. This task was to include an assessment of inter-agency coordination.

31. At the request of the Gender Working Group, United Nations Development Fund for Women undertook a review of international organizations (in New York, Washington, Geneva, Rome, Vienna, Paris and Bangkok), visited in February and March 1994.* Detailed information was obtained on their policies, structure, staffing programming, and evaluation activities as well as on interagency coordination and relations with non-governmental organizations.

32. A written and oral report summarizing the United Nations Development Fund for Women exercise was presented to the Gender Working Group in April

1994. Following discussion of the paper, the Gender Working Group concluded that:

(a) Most organizations have a commitment to gender concerns often enshrined in policy resolutions, and may have departments, programmes and/or focal points to deal with gender questions; many also have a strong commitment to science and technology. However, only four agencies had clearly identifiable gender, science and technology focal points and in all cases (except the United Nations Development Fund for Women and the United Nations International Research and Training Institute for the Advancement of Women), there was no organization-wide recognition and promotion of gender and science and technology issues.

(b) In relation to most programmes and projects, the concern is to help women gain equal access to improved technologies. There is less emphasis on involving women in the process of technology development and little attention to promoting women's increased involvement in science and technology decision-making or systematic incorporation of women's perspectives into the formal science and technology system.

(c) Intra-agency mechanisms for appraising, monitoring and evaluating gender, science and technology projects and programmes is very weak for a variety of structural, staffing and financial reasons. As a result, gender perspectives have not been integrated effectively into science and technology activities within the United Nations system.

(d) Although there is some evidence of interagency collaboration on these issues, it takes place on an *ad hoc* rather a coordinated or strategic basis; while there is increased recognition of the importance of learning from the experience of non-governmental organizations, few agencies have developed mechanisms for supporting non-governmental organizations and working effectively with them.

33. The members of the Gender Working Group also requested a follow-up review by an independent consultant. Accordingly, and within budgetary limitations, selected agencies' were visited in May 1994 and a draft report was presented to the Gender Working Group in July 1994. A matrix was prepared comparing policies across agencies.

34. Following a discussion of the consultant's report, the members of the Gender Working Group concluded that:

(a) Most United Nations agencies perceive the theme of gender, science and technology as being marginal to their central main mandate. Promoting an awareness of the relations between gender, science and technology should include the provision of practical examples of how current programmes can contain a gender bias and how obstacles can be overcome by incorporating "gender analysis" into the design of science and technology policies and programmes. The agencies and governing councils representing the member States, in recognition of the importance of gender issues, should require monitoring and regular reporting of agency actions addressing the incorporation of gender analysis and assessment into policies, programmes, and projects related science and technology.

(b) While there is some evidence to suggest that the positioning of high-level women professionals in key technical posts can assist in "rendering" science and technology policies and programming more gender-balanced and while improvements have been made in some agencies (e.g., World Health Organization, United Nations High Commissioner for Refugees) in recent years, there are still very few women in senior management or technical advisory positions. Although the gender balance should continue to improve in response to resolutions of the governing councils, the organizations should be required to report regularly on progress in the recruitment and promotion of women professionals;

(c) There is little collaboration between gender focal points and science and technology focal points within agencies with respect to the design, monitoring, and evaluation of policies, programmes and projects. Moreover, there is a lack of specific guidelines to assist scientific and technical staff to undertake this task. Recent attempts by, for example, the United Nations Industrial Development Organization and the Women, Science and Technology programme of United Nations Educational, Scientific and Cultural Organization to introduce agency-wide programmes aimed at integration among units should help promote awareness.

(d) Although a few examples exist of studies on the "impact of technology projects" on women, there is a general lack of gender-disaggregated "impact assessment" data available to improve programming. The problem of undertaking such assessments is a generic one, but there are few guidelines on how to build gender, science and technology questions into routine monitoring and evaluation.

(e) United Nations agencies tend to work in isolation owing in part to their perceived separate mandates and to difficulties in communication (lack of travel budgets, absence of e-mail networking, etc.). Although instituting formal mechanisms for coordination would not necessarily promote better exchange of information, support should be given to methods to promote and sustain exchange between gender focal points and science and technology focal points on an agency-wide basis.

(f) Although there is a general trend in the United Nations system to work with non-governmental organizations, only selected organizations, such as World Health Organization, International Labour Organisation, United Nations High Commissioner for Refugees, United Nations Development Fund for Women, and United Nations Children's Fund have established formal relations with non-governmental organizations at both the policy and field programme/project level. This trend reflects the heightened awareness in recent years of the capabilities of non-governmental organizations to contribute to development policy, including their ability to deliver cost-effective programmes and gain detailed knowledge of local communities. The experience of United Nations Development Fund for Women, International Fund for Agricultural Development, United Nations Industrial Development Organization, International Labour Organisation, and others testifies to the effectiveness of system-wide collaboration with non-governmental organizations. Agencies that have not yet fully recognized the contribution of non-governmental organizations to their activities should be encouraged to do so. A 1994 survey of United Nations Development Fund for Women identified some 650 non-governmental organizations active in the field of gender, science and technology. A consortium of these non-governmental organizations - known as the Once in Future Action Network - is actively planning a contribution to the 1995 United Nations fourth World Conference on Women in Development, so as to ensure a high profile for issues of gender in science and technology, in Beijing and beyond.

RECOMMENDATIONS

35. In light of these conclusions, the Gender Working Group make the following recommendations.

Recommendation 1:

The United Nations should be required to review its current organizational policy to ensure that gender, science and technology is formally incorporated into policy. For successful implementation of such policy, gender, science and technology specialists within each organization and agency should be required to prepare case studies and training materials. Monitoring and evaluation and statistical divisions within each organization should establish a process for the systematic collection of gender-disaggregated data. They should

furthermore collaborate to ensure common methods. Progress should be assessed on an on-going basis. A relevant specialized agency should be requested to assist the United Nations system in this task, with the United Nations secretariat for overseeing initiation and monitoring of progress. Policies should be reviewed and action taken on implementation by September 1996.

Recommendation 2:

United Nations agencies should actively respond to policies calling for recruitment of professional women by establishing clear targets and time horizons for recruitment of women into high-level professional posts with strategic importance for science and technology. There should be explicit pro-active recruitment, retention, and re-entry programmes with supporting policies for high-level professional women in science and technology. The organizations and agencies should be required to report regularly to their governing bodies on progress achieved and specific constraints encountered. In this regard, they should review early successful experiences, such as that of the Consultative Group for International Agricultural Research and the World Health Organization. Progress should be reported through the United Nations secretariat by September 1996.

Recommendation 3:

United Nations agencies should use accessible and practical guidelines for incorporating gender analysis and assessment into the design of science and technology policies, programmes and projects. Although each agency has a distinct mandate and programming approach and guidelines will have to be specific to individual agencies, a set of general guidelines that could be adapted to specific circumstances could be useful. The guidelines developed by the United Nation Development Fund for Women could serve as a basis. Specific guidelines should be developed and in place by September 1996 with briefing of relevant staff on implementation of policies. Progress should be reported annually through the United Nations secretariat.

Recommendation 4:

The United Nations should establish procedures to research, document, monitor and evaluate the gender impact of their science and technology programmes, including regular reporting of the results and lessons learned to the respective governing councils. The experience in this area of such organizations and agencies as the International Labour Organisation, the United Nations Industrial Development Organization, and the United Nations Development Fund for Women could be built upon to develop general guidelines for adoption by other agencies. Gender, science and technology specialists in each organization and agency should work together with monitoring and evaluation units to implement this process. Specific guidelines should be developed and in place by September 1996 with evidence of incorporation in at least one project document. Progress should be regularly reported through the United Nations secretariat.

Recommendation 5:

The United Nations should give full support to strengthening and sustaining informal methods of interagency networking on gender, science and technology issues. The Commission on Science and Technology for Development should interact with this network to ensure a gender perspective and mutual support in achieving goals. The United Nations should investigate alternative methods of increasing intra- and interagency communication in this area by, for example, establishing an electronic network link on gender, science and technology. This could be linked with existing non-governmental organization networks. United Nations Development Fund for Women and the United Nation Industrial

Development Organization should be called upon to facilitate this process in conjunction with the United Nations secretariat.

Recommendation 6:

The United Nations system, and particularly those agencies reviewed by the Commission Science and Technology for Development Working Group as having functions at the interface of science and technology, should incorporate "gender and science and technology" analysis into all regular programmes, and through redistribution of agency funding priorities, and provide increased regular budgetary allocations to gender units. Technically based agencies should support adequate staffing of gender experts and require training of all staff in gender analysis to ensure full incorporation of gender into their regular work programmes. Progress should be monitored through the United Nations secretariat by September 1996.

Recommendation 7:

The United Nations should recognize the value of collaboration with non-governmental organizations and expand its formal partnership with and support for these organizations both in terms of implementing field projects and obtaining policy advice and assistance with the design, implementation and evaluation of gender-sensitive technical cooperation programmes. Partnerships with the over 650 non-governmental organizations active in gender, science and technology should be forged. Models such as those being developed by the United Nations High Commissioner for Refugees could be explored and approaches suitable for each agency identified. Ongoing United Nations support for the non-governmental organization science and technology consortium, Once and Future Action Network, would assist in this process. Relevant United Nations staff focal points for gender and science and technology should be supported to participate in the on-going activities of the non-governmental organization consortium. Agencies should explore options and begin to implement plans to enhance cooperation and support to non-governmental organizations by September 1996. Progress should be reported through the United Nations secretariat. Up to 10 of the most relevant agencies should be active participants in the non-governmental consortium by September 1996.

Recommendation 8:

The Gender Working Group recommends the establishment of an Advisory Board on Gender to the Commission on Science and Technology for Development for four years to ensure that gender issues are adequately addressed in all future deliberations of the Commission on Science and Technology for Development. The advisory board should consist of seven international gender experts, appointed by the Secretary General. Among its initial responsibilities will be the task of monitoring implementation of the above recommendations.

The United Nations secretariat should support the advisory board in its activities.

IV. CONCLUSION: A DECLARATION OF INTENT

36. The report and the background papers on which it is based contain a rich collection of ideas and policy measures. They could be the basis for reform of both of the current science and technology system and of the ways in which the output of that system is used to contribute to sustainable human development for the benefit of both men and women. The specific measures adopted by each Government will necessarily depend on the national context. The changes proposed, therefore, are provided as a list of possible actions that each country may adopt according to its own specific situation.

37. Two recommendations, however, apply to all countries and a third is directed at donor Governments. The **first** is that all Governments should agree to adopt a declaration of intent on gender, science and technology for sustainable human development. This declaration would consist of important goals toward which each country should move.

38. As it is not for the Gender Working Group to suggest specific ways in which each country should implement its declaration of intent, the **second recommendation**, therefore, is that each country should establish an *ad hoc* committee to make recommendations to its own Government on how the goals in the declaration might be implemented under the specific conditions of that country. We recognize that, to implement the recommendations of its own ad hoc committee, each Government would need to pass appropriate legislation and establish regulatory policy frameworks.

39. The **third recommendation** is directed to donor countries and agencies. Donor agencies may help the national *ad hoc* committee on gender and science and technology to obtain access to relevant information, and should target financial support to projects that enable recipient countries to implement the recommendations of their own relevant *ad hoc* committee.

Box 17

A "declaration of intent" on gender, science and technology for sustainable human development

All Governments agree to work actively towards the following goals:

(1) To ensure basic education for all, with particular emphasis on scientific and technological literacy, so that all women and men can effectively use science and technology to meet basic needs.

(2) To ensure that men and women have equal opportunity to acquire advanced training in science and technology and to pursue careers as technologists, scientists and engineers.

(3) To achieve gender equity within science and technology institutions, including policy and decision-making bodies.

(4) To ensure that the needs and aspirations of women and men are equally taken into account in the setting of research priorities and in the design, transfer and application of new technologies.

(5) To ensure all men and women have equal access to the information and knowledge, particularly scientific and technological knowledge, that they need to improve their standard of living and quality of life.

(6) To recognize local knowledge systems, where they exist, and their gender-specific nature as a source of knowledge complementary to modern science and technology and also valuable for sustainable human development.

Box 18

MECHANISMS FOR ACHIEVING THE GOALS OF THE DECLARATION OF INTENT

The manner in which Governments adopt strategies to achieve these goals will depend on the national context. It is, therefore, recommended that:

(1) Each country establish an ad hoc committee to review the national situation regarding gender and science and technology and to devise action plans and time horizons so as to achieve the goals stated in the declaration of intent.

(2) These ad hoc committees should be constituted with equitable participation of women and men and with involvement of end-users and stake-holders.

(3) Country reports on progress in achieving the goals of the declaration of intent should be published.

Box 19

RECOMMENDATION TO DONORS

Donor agencies should target their financial support at projects that enable recipient countries to implement the recommendations of their own ad hoc committee on gender and science and technology.

Notes

1. United Nations Development Programme, *Administrator Speech* UNDP, New York, 1994.

2. United Nations Development Programme, *Human development report*, UNDP, New York, 1993.

3. APPROTECH-Asia. 1992. *Mainstreaming women in science and technology*, WISE-Thailand, Bangkok, Thailand.

3a. Baringa, Marcia. 1994. Overview: surprises across the cultural divide. *Science*, 263. Ellis, Patricia. 1990. *Measures increasing the participation of girls and women in technical and vocation education and training: a Caribbean study*. Commonwealth Secretariat, London, UK. Logue, H.A.; Talapessy, L.M., ed. 1993. *Women in science: international workshop proceedings*. European Commission, Brussels, Belgium. National Advisory Board on Science and Technology. 1993. *Winning with women in trades, technology, science and engineering*. Government of Canada, Ottawa, Canada. Office of Science and Technology. 1993. *The rising tide: a report on women in science, engineering and technology*. Office of Science and Technology, London, United Kingdom. sub-Sahara Africa Programme. 1993. *Science in Africa: women leading from strength*. AAAS, Washington, DC, USA. UNESCO. 1994. *Statistical yearbook 1990-1991*. UNESCO, Paris, France. WISET (Women in Science, Engineering and Technology Advisory Group). 1994. *Draft report*. WISET, Australia.

4. Office of International Affairs. 1994. *Barriers faced by developing country women entering professions in science and technology*. Board on Science and Technology for International Development, National Research Council, Washington, DC, USA.

5. CGIAR (Consultative Group on International Agricultural Research). 1994. *Partners in selection: bean breeders and women bean experts in Rwanda*. CGIAR, Washington, DC, USA.

6. Ministry of Education, Government of Botswana. January 1991. *Girls and Women in Science: Science and Technology Roadshow*.

7. *Equity, Knowledge and Empowerment: The Gender Dimension of Science and Technology for Sustainable Human Development*. International Development Research Centre, Ottawa, 1995.

8. The agencies are: International Trade Centre UNCTAD/GATT, United Nations Children's Fund, United Nations Conference on Trade and Development, United Nations Development Fund for Women, United Nations Development Programme, United Nations Economic and Social Commission for Asia and the Pacific, United Nations Environment Programme, United Nations Fund for Population Activities, United Nations High Commissioner for Refugees, United Nations International Research and Training Institute for the Advancement of Women, United Nations Research Institute for Social Development, United Nations University, World Food Programme, Consultative Group on International Agricultural Research (World Bank), Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, United Nations Education, Scientific and Cultural Organization, United Nations Industrial Development Organization, World Bank, World Health Organization, World Intellectual Property Organization, Inter-American Development Bank, International Coffee Organization.

9. They were: United Nations Conference on Trade and Development, United Nations Development Fund for Women, United Nations High Commissioner for Refugees, United Nations Research Institute for Social Development, International Atomic Energy Agency, International Labour Organization, United Nations Educational, Scientific and Cultural Organization, United Nations High Commissioner for Refugees, United Nations Industrial Development Organization.

10. International Development Research Centre, World Women's Veterinary Association. 1994. *Gender in Science and Technology for Sustainable and Equitable Development.*

Annex

The Process
An example of the new working style of Commission on Science and Technology for Development

The **Gender Working Group (GWG)** undertook a highly participatory and inclusive process throughout the course of its two years of work. The Gender Working Group consisted of eight delegates from the countries of Burundi, of China, Costa Rica, Netherlands, Romania, Saudi Arabia, United Republic of Tanzania and United Kingdom. As all eight members were men, the first action was to form an advisory board of women international policy experts in gender, science and technology from: Brazil, China, Costa Rica, Egypt, Netherlands, Peru, Romania, United States of America and Uganda, to join as equal members in reaching a consensus report. A director of studies was appointed to design and coordinate the process. An active fund-raising campaign secured funds from a range of donors and individuals in support of the work on gender of the Commission on Science and Technology for Development.

Close collaboration was forged from the outset with the Commission on the Status for Women to establish links with policy preparations for the 1995 Fourth World Conference on Women in Development in Beijing. The first meeting of the Gender Working Group was held in conjunction with the Expert Group Meeting on Gender in Science and Technology organized by the United Nation Development Fund for Women for the Secretary General of the Beijing Conference which brought together over 60 international experts on gender, science and technology. Nine themes were selected for analysis and papers commissioned from experts to provide the substance for subsequent deliberations. The full text of the commissioned papers will be published by the International Development Research Centre as a book entitled Equity, Knowledge and Empowerment. Interim reports were tabled by the Chairperson at the March 1994 intergovernmental Beijing preparatory meeting in New York, and by Gender Working Group members at three further regional Beijing preparatory meetings.

A concerted effort was made to tap into the rich base of knowledge and expertise of the large and active community of women's non-governmental organizations active in the domain of gender, science and technology. A guidebook Gender in Science and Technology for Sustainable and Equitable Development* was compiled by the World's Women Veterinary Association as a background document and tabled by the Secretary General of the Beijing Conference for the Commission on the Status of Women. A team of research assistants prepared profiles of previous recommendations in each sector.

An extensive review of the United Nations system was commissioned and a report of agency performance in gender, science and technology prepared. A matrix summarizing performance indicators including corporate policy, human resource policy, programme resource allocation, and impact analysis procedures was prepared to permit cross-agency comparison. A set of recommendations was agreed upon for transmission to the United Nations Economic and Social Council.

The draft report was circulated to over 350 science advisory boards, academies, royal societies, research centres, United Nations organizations and agencies and non-governmental organizations for comment. The report represents a consensus of the international team of the Gender Working Group but it also reflects an example of a highly participatory process.

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* International Development Research Centre, World Women's Veterinary Association, 1994, Gender in Science and Technology for Sustainable and Equitable Development.

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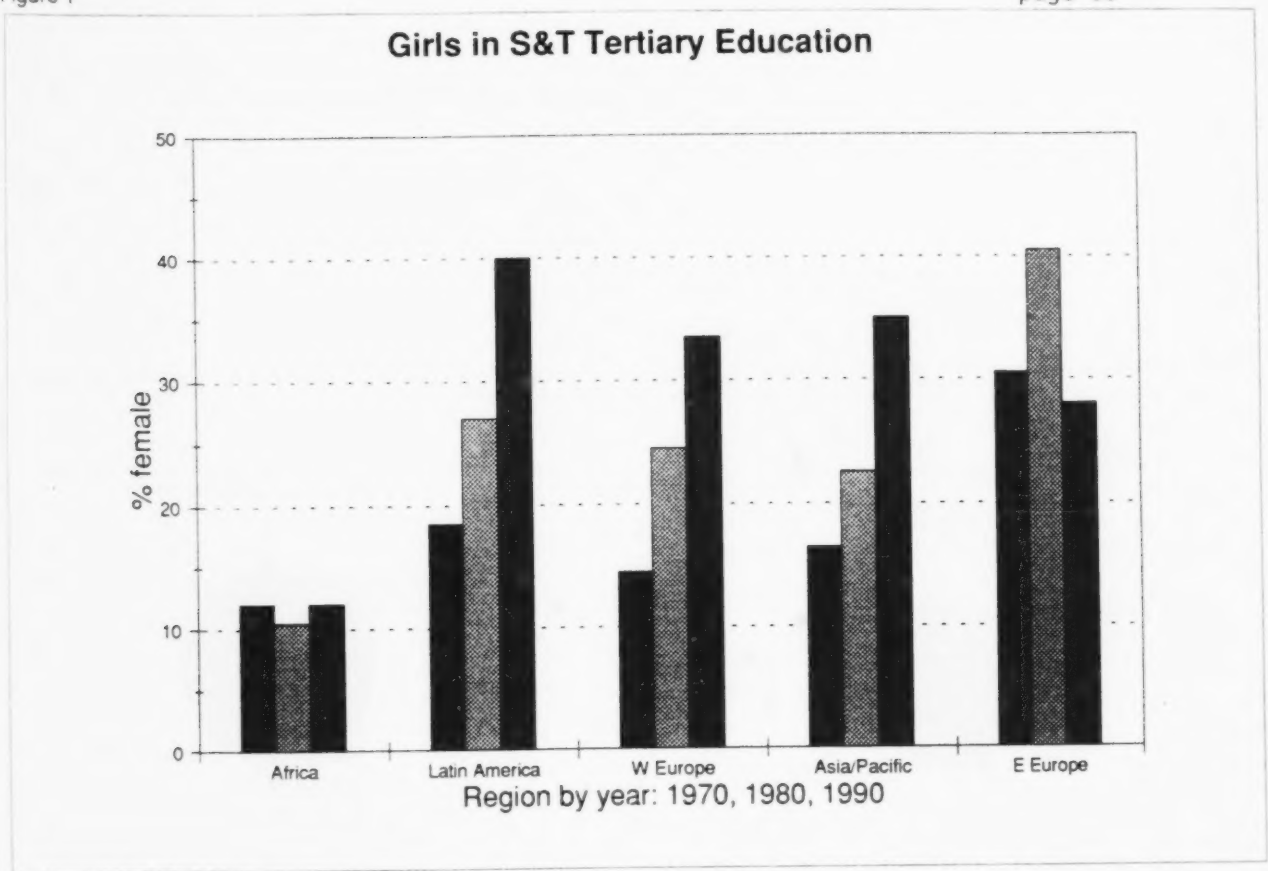
Glossary of acronyms

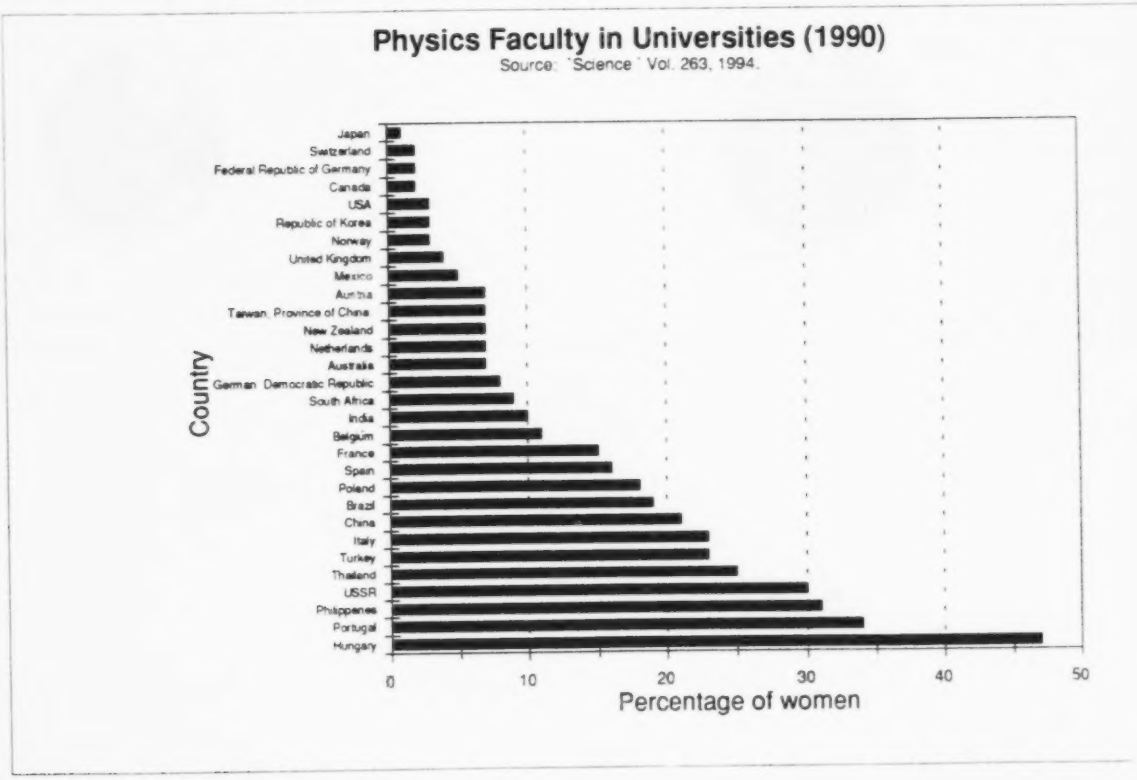
APPROTECH	Appropriate Technology - Asia
CGIAR	Consultative Group for International Agricultural Research
CSW	Commission on the Status of Women
ECOSOC	United Nations Economic and Social Council
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
GAD	Gender And Development
GASAT	Gender and Science and Technology
GSD	Gender and Sustainable Development
IAEA	International Atomic Energy Agency
IDB	Inter-American Development Bank
IDRC	International Development Research Centre, Ottawa, Canada
IFAD	International Fund for Agricultural Development
IFIAS	International Federation of Institutes for Advanced Study
IICA	Inter-American Institute for Cooperation on Agriculture
ILO	International Labour Organisation
INSTRAW	International Research and Training Institute for the Advancement of Women
IT	Information Technology
ITC	United Nations International Trade Centre (UNCTAD/GATT)
ITDG	Intermediate Technology Development Group
NGO	Non-governmental Organization
OECD	Organization for Economic Cooperation and Development
PAWETS	Pan African Women Engineers, Technicians and Scientists Network
SEWA	Self Employed Women's Association
SWAGSD	Senior Women's Advisory Group on Sustainable Development
TAMWA	Tanzania Media Women's Association
TWOWS	Third World Organization of Women in Science
UNCED	United Nations Conference on Environment and Development
UNCSTD	United Nations Commission on Science and Technology for Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNIFEM	United Nations Development Fund for Women
UNRISD	United Nations Research Institute for Social Development
UNU	United Nations University
UNV	United Nations Volunteers
WFP	United Nations World Food Programme
WHO	World Health Organization
WID	Women In Development
WIPO	World Intellectual Property Organization
WISE	Women in Science and Engineering
WISENET	Women in Science Enquiry Network
WWVA	World Women's Veterinary Association

Figure 1



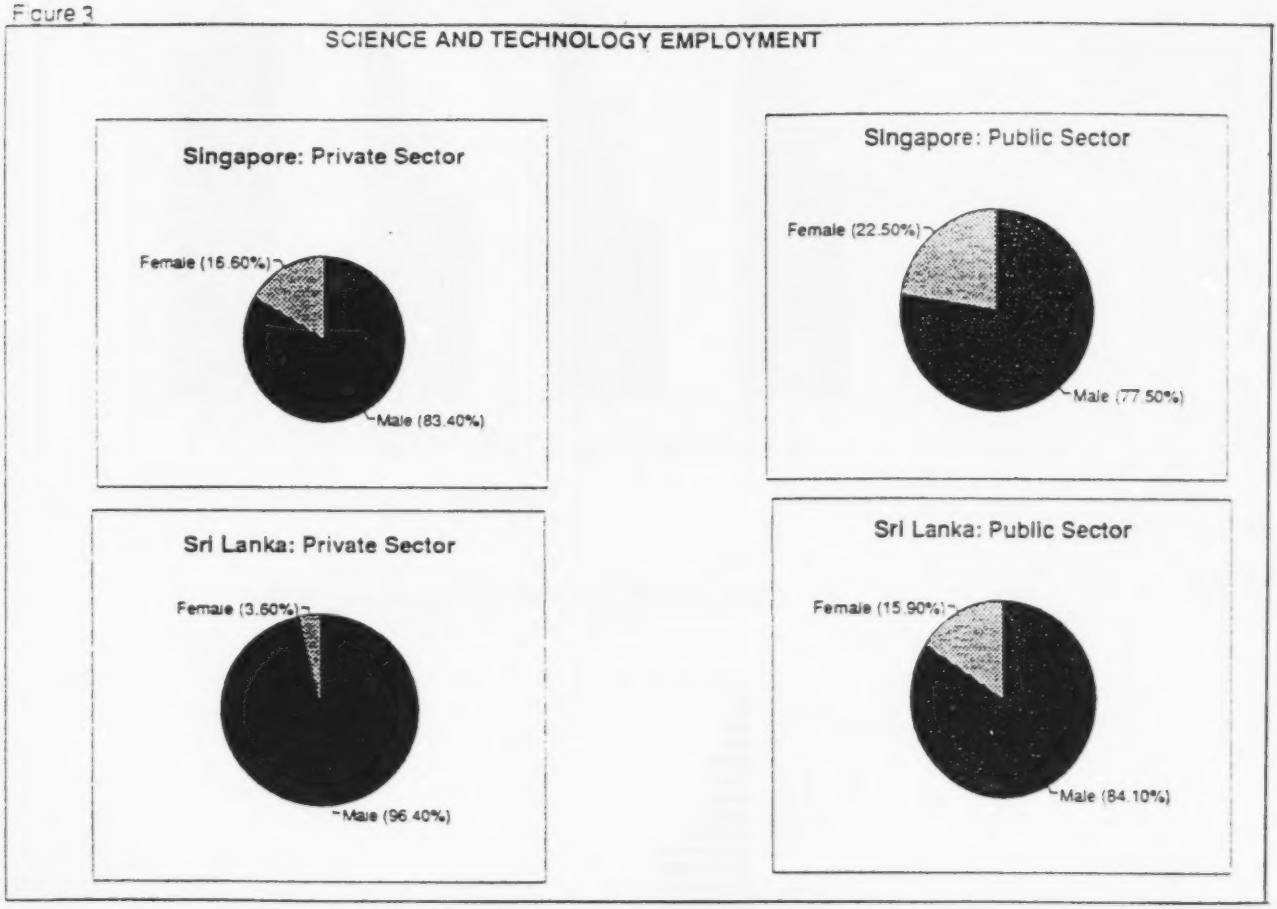
Source: UNCTAD, 1994

Figure 2



Source: Jim Megaw (1990) in Barinaga, Science Vol. 263, 1994

Figure 3


SCIENCE AND TECHNOLOGY EMPLOYMENT
Singapore: Private Sector
Female (16.60%)
Male (83.40%)
Singapore: Public Sector
Female (22.50%)
Male (77.50%)
Sri Lanka: Private Sector
Female (3.60%)
Male (96.40%)
Sri Lanka: Public Sector
Female (15.90%)
Male (84.10%)